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For related information see also *34 Fluid Mechanics and Heat Transfer*

03 AIR TRANSPORTATION AND SAFETY 2686

Includes passenger and cargo air transport operations; and aircraft accidents.

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Includes aircraft simulation technology.

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07 AIRCRAFT PROPULSION AND POWER 2693

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For related information see also *Aeronautics*

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20 SPACECRAFT PROPULSION AND POWER 2699

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85 URBAN TECHNOLOGY AND TRANSPORTATION **2821**
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) **2822**

89 ASTRONOMY **2827**
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS **2828**
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION **2829**
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance.* For space stations see *15 Launch Vehicles and Space Vehicles.*

92 SOLAR PHYSICS **2830**
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION **2830**
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

99 GENERAL **N.A.**

Note: N.A. means that no abstracts were assigned to this category for this issue.

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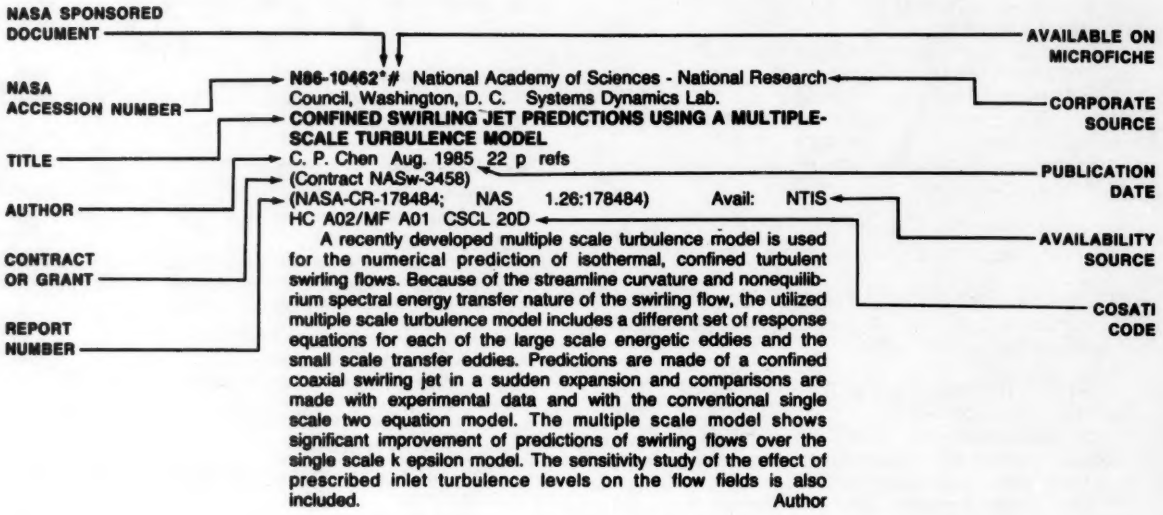
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N86-10462*# National Academy of Sciences - National Research Council, Washington, D. C. Systems Dynamics Lab.
CORPORATE SOURCE
TITLE
CONFINED SWIRLING JET PREDICTIONS USING A MULTIPLE-SCALE TURBULENCE MODEL
AUTHOR
C. P. Chen Aug. 1985 22 p refs
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(NASA-CR-178484; NAS 1.26:178484) Avail: NTIS
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HC A02/MF A01 CSCL 20D
COSATI CODE
A recently developed multiple scale turbulence model is used for the numerical prediction of isothermal, confined turbulent swirling flows. Because of the streamline curvature and nonequilibrium spectral energy transfer nature of the swirling flow, the utilized multiple scale turbulence model includes a different set of response equations for each of the large scale energetic eddies and the small scale transfer eddies. Predictions are made of a confined coaxial swirling jet in a sudden expansion and comparisons are made with experimental data and with the conventional single scale two equation model. The multiple scale model shows significant improvement of predictions of swirling flows over the single scale k epsilon model. The sensitivity study of the effect of prescribed inlet turbulence levels on the flow fields is also included.
Author

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N86-26277*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SUMMARY OF RESULTS OF NASA F-15 FLIGHT RESEARCH PROGRAM
Frank W. Burcham, Jr., Gary A. Trippensee, David F. Fisher, and Terrill W. Putnam Apr. 1986 34 p ref Presented at the AIAA 3rd Flight Testing Conference, Las Vegas, Nevada, 2-4 Apr. 1986 (NASA-TM-86811; H-1341; NAS 1.15:86811; AIAA-86-9761) Avail: NTIS HC A03/MF A01 CSCL 01B

NASA conducted a multidisciplinary flight research program on the F-15 airplane. The program began in 1976 when two preproduction airplanes were obtained from the U.S. Air Force. Major projects involved stability and control, handling qualities, propulsion, aerodynamics, propulsion controls, and integrated propulsion-flight controls. Several government agencies and aerospace contractors were involved. In excess of 330 flights were flown, and over 85 papers and reports were published. This document describes the overall program, the projects, and the key results. The F-15 was demonstrated to be an excellent flight research vehicle, producing high-quality results. Author

N86-26278# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AEROSPACE KNOWLEDGE MAGAZINE (SELECTED ARTICLES)
Xin Li, Zhenwu Wang, and Xin.Wu 15 Jan. 1986 19 p Transl. into ENGLISH from Hangkong Zhishi (China), no. 6, 1985 p 17-21 (AD-A164720; FTD-ID(RS)T-1008-85) Avail: NTIS HC A02/MF A01 CSCL 01/3

This Chinese translation is of three articles from Aerospace Knowledge Magazine. The articles are Su-7 and Su-17 about the Soviet fighter bomber and the variable geometry swept-wing fighter bomber; Infrared Decoy about the scapegoat infrared countermeasure against infrared guided missiles. Smoke and flame decoys, composite decoys and fuel type decoys are also discussed in this article. The last article is entitled Distinguishing between several Soviet aircraft. GRA

N86-26279# Air Command and Staff Coll., Maxwell AFB, Ala.
WHAT USAF AIRCRAFT SHOULD BE THE WILD WEASEL OF THE 1990'S?: AN ASSESSMENT OF THE F-4G, THE F-15WW, AND F-16WW M.S. Thesis
Michael J. Neitzel 7 Jun. 1985 125 p
(AD-A164727) Avail: NTIS HC A06/MF A01 CSCL 01/3

The USAF Wild Weasel mission was born in 1965 during the Vietnam conflict. The purpose of the mission was to counter the serious radar-directed threats that were decimating the US fighter arsenal. While the current F-4G Wild Weasel aircraft has effectively met the threat into the 1980's, its capabilities reflect the aircraft's 1950's design. Meanwhile, the Soviet Union is fielding many technologically advanced radar-directed threats that bring the adequacy of the F-4G into question. This study investigated what characteristics will be required to defeat the threat of the 1990's. Next, the F-4G, F-15WW, and F-16 Wild Weasel proposal were compared against the aircraft characteristics needed (as determined by a poll of experienced officers) to survive the threats in the 1990's. This thesis concludes that the F-15WW possesses the most desirable characteristics to serve as the Wild Weasel aircraft for the 1990's. GRA

N86-26280# Army Command and General Staff Coll., Fort Leavenworth, Kansas.
THE C-17: AN ATTEMPT AT INCREASED AIRLIFT VERSATILITY M.S. Thesis
John W. Stone 7 Jun. 1985 127 p
(AD-A164822) Avail: NTIS HC A07/MF A01 CSCL 01/3

The Airlift Master Plan was developed as a guide for achieving long-term military airlift objectives. The cornerstone of the plan is the development and acquisition of the C-17. Although the C-17's direct-delivery concept is new, the quest for expanded aircraft versatility has been continually pursued in previous airlift aircraft development programs. Thus the C-17 is not the first aircraft that has attempted to combine the traditionally separate roles of intertheater and intratheater airlift. The most recent attempt at developing an aircraft capable of meeting both strategic and tactical requirements resulted in the C-5A. The C-5A failed to achieve the operational versatility predicted by its proponents and that failure has given rise to serious questions in regard to the C-17's probability of success in realizing its expanded airlift goals. A comparison of the C-5A and C-17 programs revealed the differences in concept formulation, design and acquisition strategy which will allow the C-17 to achieve its operational goals. The study further concludes that the direct-delivery concept is a valid airlift objective and current technology permits the development of an aircraft with the performance capabilities necessary to fulfill that objective. GRA

N86-26281# Air Force Academy, Colo.
AIR FORCE ACADEMY AERONAUTICS DIGEST Final Report
John H. Russell and Michael Hale Sep. 1985 85 p
(AD-A164940; USAFA-TR-85-11) Avail: NTIS HC A05/MF A01 CSCL 05/9

This Digest covers unclassified research in aeronautics by individuals assigned to or associated with the United States Air Force Academy. Partial contents: Aerodynamics - Unsteady forces acting on a flat plate airfoil undergoing chord deformation, and Unsteady surface pressure measurements on a pitching airfoil; and Engineering Education - Undergraduate airbreathing propulsion at the US Air Force Academy, and How to fairly account for an excused exam. GRA

N86-26282# Naval Postgraduate School, Monterey, Calif.
AN ANALYSIS OF S-3 SDLM (STANDARD DEPOT LEVEL MAINTENANCE) CORROSION DOCUMENTATION PROCEDURES M.S. Thesis
Steven L. Hanson and Mark E. Karr Dec. 1985 77 p
(AD-A165588; NPS554-85-011) Avail: NTIS HC A05/MF A01 CSCL 05/1

When senior personnel in Naval aviation are asked the question, How much time and money are we spending on corrosion prevention and correction?, fairly accurate estimates can be obtained for the organizational and intermediate levels of maintenance because they break out these costs in their maintenance data reporting systems. It is virtually impossible to quantify these same costs at the depot level since their current reporting system will not allow for the collection of such information. A second problem, caused by this rather limited reporting system, concerns the inability of the depot level engineering staff to gather sufficient accurate information about the types, extent, and locations of corrosion that occur on aircraft. This report provides a system design and implementation plan for corrosion monitoring for the Naval Air Rework Facility at Alameda, California. A computerized system for corrosion data collection and processing is needed. Research in this area led to the Depot Maintenance Data System (DMDS). GRA

N86-26283*# Notre Dame Univ., Ind. Dept. of Aerospace and Mechanical Engineering.
PROCEEDINGS OF THE CONFERENCE ON LOW REYNOLDS NUMBER AIRFOIL AERODYNAMICS
Thomas J. Mueller, ed. Jun. 1985 356 p refs
(NASA Order L-77177-B; Grant N00014-85-G-0123)
(NASA-CR-177308; NAS 1.26:177308; AD-A163609; UNDAS-CP-77B123) Avail: NTIS HC A16/MF A01 CSCL 01B

Current interest in a variety of low Reynolds number applications has focused attention on the design and evaluation of efficient airfoil sections at chord Reynolds numbers from about 100,000 to about 1,000,000. These applications include remotely piloted vehicles (RPVs) at high altitudes, sailplanes, ultra-light man-carrying/man powered aircraft, mini-RPVs at low altitudes and wind turbines/propellers. Although the design and evaluation techniques for airfoil sections above chord Reynolds numbers of 500,000 are reasonably well developed problems related to boundary layer separation and transition have made it difficult to extend these techniques to lower Reynolds numbers. Presently available design and analysis techniques require improved criteria for laminar separation transition, reattachment and turbulent separation. Mathematical models of these complex phenomena require additional very careful experimental studies. GRA

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N86-26284*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A COMPUTATIONAL TRANSONIC FLUTTER BOUNDARY TRACKING PROCEDURE M.S. Thesis
J. W. Gallman, J. T. Batina, and T. Y. Yang Mar. 1986 13 p refs Presented at 27th Structures, Structural Dynamics and Materials Conference, San Antonio, Tex., 19-21 May 1986; Sponsored by AIAA Previously announced in IAA as A86-0902
(Grant NAG1-372)
(NASA-TM-87708; NAS 1.15:87708) Avail: NTIS HC A02/MF A01 CSCL 01A

An automated flutter boundary tracking procedure for the efficient calculation of transonic flutter boundaries is presented. The procedure uses aeroelastic responses to march along the boundary by taking steps in speed and Mach number, thereby reducing the number of response calculations previously required to determine a transonic flutter boundary. Flutter boundary results are presented for a typical airfoil section oscillating with pitch and plunge degrees of freedom. These transonic flutter boundaries are in good agreement with exact boundaries calculated using the conventional time-marching method. The tracking procedure is extended to include static aeroelastic twist as a simulation of the static deformation of a wing and contains all of the essential features that are required to apply it to practical three-dimensional cases. The procedure is also applied to flutter boundaries as a function of structural parameters. Author

N86-26285*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PLUME CHARACTERISTICS OF SINGLE-STREAM AND DUAL-FLOW CONVENTIONAL AND INVERTED-PROFILE NOZZLES AT EQUAL THRUST
Uwe H. vonGlahn and Jack H. Goodykoontz 1986 39 p refs Presented at the 4th Applied Aerodynamics Conference, San Diego, Calif. 9-11 Jun. 1986; sponsored by AIAA
(NASA-TM-87323; E-3060; NAS 1.15:87323; AIAA-86-1809) Avail: NTIS HC A03/MF A01 CSCL 01A

The plume velocity and temperature decay rates of single-stream, conventional dual-flow and inverted-profile dual-flow nozzles are compared at equal values of ideal thrust over a wide range of flow conditions. The comparisons are made in terms of constant velocity and temperature contour maps. The results show that both dual-flow nozzle types have much greater plume velocity and temperature decay rates than those of equivalent thrust single-stream nozzles when the respective secondary flows were at ambient temperature. With hot secondary flows, the inverted-profile dual-flow plumes decayed significantly faster than those of single-stream nozzles; however, the decay rates for the conventional dual-flow streams were about the same as those for the single-stream nozzles. Consequently, with hot secondary flows, the inverted-profile dual-flow plumes decayed much faster than the conventional dual-flow plumes at equal thrust. Author

N86-26286*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EXPERIMENTAL RESULTS FOR A FLAPPED NATURAL-LAMINAR-FLOW AIRFOIL WITH HIGH LIFT/DRAG RATIO
Robert J. McGhee, Jeffrey K. Viken (Mandex, Inc., Falls Church, Va.), Werner Pfenninger (Engineering Science Consultants, Grafton, Va.), William D. Beasley, and William D. Harvey May 1984 325 p Previously announced in IAA
(NASA-TM-85788; NAS 1.15:85788) Avail: NTIS HC A14/MF A01 CSCL 01A

Experimental results have been obtained for a flapped natural-laminar-flow airfoil, NLF(1)-0414F, in the Langley Low-Turbulence Pressure Tunnel. The tests were conducted over a Mach number range from 0.05 to 0.40 and a chord Reynolds number range from about 3.0 x 10(6) to 22.0 x 10(6). The airfoil was designed for 0.70 chord laminar flow on both surfaces at a lift coefficient of 0.40, a Reynolds number of 10.0 x 10(6), and a Mach number of 0.40. A 0.125 chord simple flap was incorporated in the design to increase the low-drag, lift-coefficient range. Results were also obtained for a 0.20 chord split-flap deflected 60 deg. Author

N86-26287*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
UNIFORMLY HIGH ORDER ACCURATE ESSENTIALLY NON-OSCILLATORY SCHEMES 3
Ami Harten (California Univ., Los Angeles), Bjorn Engquist, Stanley Osher, and Sukumar R. Chakravarthy (Rockwell International Corp., Thousand Oaks, Calif.) Apr. 1986 98 p refs
(Contracts NAS1-17070; NAS1-18107; Grants NAG1-270; NSF DMS-85-03294; DAAG29-85-K-0190)
(NASA-CR-178101; ICASE-86-22; NAS 1.26:178101) Avail: NTIS HC A05/MF A01 CSCL 01A

In this paper (a third in a series) the construction and the analysis of essentially non-oscillatory shock capturing methods for the approximation of hyperbolic conservation laws are presented. Also presented is a hierarchy of high order accurate schemes which generalizes Godunov's scheme and its second order accurate MUSCL extension to arbitrary order of accuracy. The design involves an essentially non-oscillatory piecewise polynomial reconstruction of the solution from its cell averages, time evolution through an approximate solution of the resulting initial value

problem, and averaging of this approximate solution over each cell. The reconstruction algorithm is derived from a new interpolation technique that when applied to piecewise smooth data gives high-order accuracy whenever the function is smooth but avoids a Gibbs phenomenon at discontinuities. Unlike standard finite difference methods this procedure uses an adaptive stencil of grid points and consequently the resulting schemes are highly nonlinear. Author

N86-26288*# United Technologies Research Center, East Hartford, Conn.
ANALYSIS OF TRANSITIONAL SEPARATION BUBBLES ON INFINITE SWEPT WINGS
R. L. Davis and J. E. Carter Washington Jun. 1986 39 p refs (Contract NAS1-16585)
(NASA-CR-3956; NAS 1.26:3956) Avail: NTIS HC A03/MF A01 CSCL 01A

A previously developed two-dimensional local inviscid-viscous interaction technique for the analysis of airfoil transitional separation bubbles, ALESEP (Airfoil Leading Edge Separation), has been extended for the calculation of transitional separation bubbles over infinite swept wings. As part of this effort, Roberts' empirical correlation, which is interpreted as a separated flow empirical extension of Mack's stability theory for attached flows, has been incorporated into the ALESEP procedure for the prediction of the transition location within the separation bubble. In addition, the viscous procedure used in the ALESEP techniques has been modified to allow for wall suction. A series of two-dimensional calculations is presented as a verification of the prediction capability of the interaction techniques with the Roberts' transition model. Numerical tests have shown that this two-dimensional natural transition correlation may also be applied to transitional separation bubbles over infinite swept wings. Results of the interaction procedure are compared with Horton's detailed experimental data for separated flow over a swept plate which demonstrates the accuracy of the present technique. Wall suction has been applied to a similar interaction calculation to demonstrate its effect on the separation bubble. The principal conclusion of this paper is that the prediction of transitional separation bubbles over two-dimensional or infinite swept geometries is now possible using the present interacting boundary layer approach. Author

N86-26289*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TABLES FOR CORRECTING AIRFOIL DATA OBTAINED IN THE LANGLEY 0.3-METER TRANSONIC CRYOGENIC TUNNEL FOR SIDEWALL BOUNDARY-LAYER EFFECTS
Renaldo V. Jenkins and Jerry B. Adcock Jun. 1986 21 p refs (NASA-TM-87723; NAS 1.15:87723) Avail: NTIS HC A02/MF A01 CSCL 01A

Tables for correcting airfoil data taken in the Langley 0.3-meter Transonic Cryogenic Tunnel for the presence of sidewall boundary layer are presented. The corrected Mach number and the correction factor are minutely altered by a 20 percent change in the boundary layer virtual origin distance. The sidewall boundary layer displacement thicknesses measured for perforated sidewall inserts and without boundary layer removal agree with the values calculated for solid sidewalls. Author

N86-26290# Air Force Geophysics Lab., Hanscom AFB, Mass.
FACTORS AFFECTING THE VERTICAL MOTION OF A ZERO-PRESSURE, POLYETHYLENE, FREE BALLOON Environmental Research Papers, 31 Dec. 1983 - 31 Dec. 1984
James F. Dwyer 31 May 1985 108 p refs
(AD-A164596; AFGL-TR-85-0130; AFGL-ERP-921) Avail: NTIS HC A06/MF A01 CSCL 20/4

This paper discusses existing aerodynamic-thermodynamic models for predicting the vertical motion of free balloon systems. It demonstrates that: (1) the aerodynamic drag coefficient model should be based on Froude number and fractional volume as well as Reynolds number; (2) there has been a widespread error in definition of the instantaneous mass of the balloon film involved in the heat transfer process; (3) the gas bubble cannot be modelled as a sphere; (4) the gas bubble is asymmetrical except when near or at its natural ceiling altitude; and (5) the actual gas bubble shape, and most probably the added mass, is directly related to the type of gore pattern. Finally, a procedure is proposed for the analysis of actual flight data to enable the development of a practical, but also theoretically sound, model of the aerodynamic drag coefficient of a zero-pressure, free balloon- and subsequent refinement of the heat transfer models for direct and reflected solar energy. GRA

N86-26291# Woodrow Wilson International Center for Scholars, Washington, D.C. Asia Program.
THE EFFECTS ON ROTOR NONUNIFORM INFLOW HARMONIC CONTENT OF UNEVEN CIRCUMFERENTIAL DISTRIBUTION OF JET ENGINE INLET GUIDE VANES
Margaret R. Hinsman Jan. 1986 39 p refs
(Contract N00024-85-C-6041)
(AD-A164629) Avail: NTIS HC A03/MF A01 CSCL 20/4

A computative parametric study was conducted to investigate the effects of vane section geometry, vane number, and primarily, uneven circumferential vane spacing on the harmonic content of the wake field produced by a row of jet engine inlet guide vanes (IGV). As parameters were varied, the harmonic content of the resulting wake field was analyzed for its potential effect on unsteady pressures at the rotor. A semi-empirical model is presented which was used to generate the two-dimensional flow field downstream of the IGV plane. Results show that uneven angular spacing of IGV should not be employed for reducing unsteady pressures experienced by the rotor. In fact, manufacturing tolerances, relative to IGV angular location, of evenly spaced vanes should be minimized to minimize unsteady pressures. GRA

N86-26292# United Technologies Research Center, East Hartford, Conn.
VISCID/INVISCID INTERACTION ANALYSIS OF SUBSONIC TURBULENT TRAILING-EDGE FLOWS Final Report, Sep. 1983 - Jul. 1985
Mark Barnett and Joseph M. Verdon Dec. 1985 56 p
(AD-A165207; UTRC/R85-956634-6) Avail: NTIS HC A04/MF A01 CSCL 20/4

Subsonic turbulent flow past thin airfoil trailing edges is studied using a finite Reynolds number viscid/inviscid interaction model. Here, the flow in the outer or inviscid region is governed by the equations of linearized potential flow theory, while that in the inner or viscous region is governed by Prandtl's boundary-layer equations cast in terms of Levy Lees variables. The effects of turbulence are represented using an algebraic turbulence model based on the eddy viscosity concept. The flow in the vicinity of the local strong interaction is determined by iteratively matching the solutions in the inviscid and viscous regions using a quasi-simultaneous coupling procedure. Turbulent mean flow solutions have been obtained for a range of symmetric and asymmetric wedge shaped trailing edge geometries. Results illustrating the effects of airfoil thickness and loading on the detailed mean-flow behavior in the trailing edge/near wake region are presented. GRA

N86-26293# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
LAMINAR AND TURBULENT BOUNDARY-LAYER CALCULATIONS ON THE LEEWARD SURFACE OF A SLENDER DELTA WING AT INCIDENCE
A. C. deBruin 13 Apr. 1984 20 p Submitted for publication
(NLR-MP-84040-U; B8577053; ESA-86-96969) Avail: NTIS HC A02/MF A01

The boundary layer on the leeward surface of a slender delta wing at incidence was calculated for fully laminar flow and the case with artificial boundary layer tripping at the 50% semispan location. The behavior of the predicted boundary layer properties is qualitatively in good agreement with experimental observations. The rather large difference between the potential flow and experimental pressure distribution causes a discrepancy between the predicted and the experimentally observed location of secondary separation. It is expected that the potential flow pressure

distribution can be improved when the leading-edge and the secondary separation vortex sheet are correctly modeled in the potential flow calculation method. ESA

N86-26294# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
ANALYSIS OF HIGH REYNOLDS NUMBER WIND TUNNEL TESTS OF THE SEMISPAR
E. Willemsen, C. Leynse, and G. Graaf (Shell Internationale Petroleum Maatschappij B.B., Netherlands) 5 Feb. 1985 14 p Presented at the 17th Offshore Technology Conference, Houston, Tex., 6-9 May 1985
(NLR-MP-85014-U; B8577054; ESA-86-96976) Avail: NTIS HC A02/MF A01

Aerodynamic load measurements were performed on a 1:50 scale model of the semispar offshore platform concept to predict the loads exercised by the current on the full-scale structure. The test program comprised measurements with the model in even-keel and tilted conditions, in which the effects of ballast leg lengths were also investigated. All tests were carried out in uniform flow conditions, with test results corrected for wind-tunnel wall constraints. The effect of surface roughness on the measurements was investigated at various Reynolds numbers. Results obtained by applying drag calculation rules for rough, three-dimensional, circular cylinders and platform design rules concerning shielding are in good agreement with test results. Vertical forces exercise a large influence on overturning moments, in even keel and in tilted model conditions. ESA

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N86-26295# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
A DEMONSTRATION EXPERT SYSTEM FOR IMPLEMENTING EMERGENCY PROCEDURES IN A HIGH-PERFORMANCE FIGHTER AIRCRAFT
Brenda L. Belkin Apr. 1986 14 p refs
(MAE-1749) Avail: NTIS HC A02/MF A01

A demonstration expert system was developed using a knowledge acquisition tool to simulate the operation of an electronic pilot's assistant operating on-board a high-performance fighter aircraft. The task selected for this simulation was the implementation of in-flight emergency procedures for the canopy loss scenario described in the F-16 Flight Manual. Four modes of pilot assistance operation were identified. Two modes require the Electronic Pilot's Assistant to help the pilot with routine flight tasks. The other two modes require the Electronic Pilot's Assistant to autonomously plan and execute procedures to maintain control of the aircraft in the event the pilot is incapacitated or subject to unmanageable workload. Author

N86-26296*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LIGHTNING DISCHARGE PROTECTION ROD Patent Application
Charles F. Bryan, Jr., inventor (to NASA) Filed 24 Apr. 1986 14 p Sponsored by NASA
(NASA-Case-LAR-13470-1; NAS 1.71:LAR-13470-1; US-Patent-Appl-SN-855983) Avail: NTIS HC A02/MF A01 CSCL 01C

This invention is a system for protecting an in-air vehicle from damage due to the craft sustaining a lightning strike. It is an extremely simple device consisting of a sacrificial graphite composite rod, approximately the diameter of a pencil with a length of about five inches. The sacrificial rod is constructed with the graphite fibers running axially within the rod in a manner that best provides a path of conduction axially from the trailing edge of an aircraft to the trailing end of the rod. The sacrificial rod is inserted into an attachment hole 32 machined into trailing edges of aircraft flight surfaces, such as vertical fin cap 31, and attached with adhesive in a manner not prohibiting the conduction path between the rod and aircraft. The trailing end of rod may be tapered for aerodynamic and esthetic requirements. This rod is sacrificial but has the capability to sustain several lightning strikes and still provide protection. The novelty of this invention appears to reside in a system for protecting the most vulnerable parts of an in-air vehicle when the craft is hit by lightning with an extremely simple and inexpensive device. The materials are easily procured and the sacrificial rod generally can be constructed from the same composite as the flight or control surface to be protected. The protection extends to several in-air lightning strikes and provides protection to aircraft parts manufactured from all materials including organic composites. NASA

N86-26297# Federal Aviation Administration, Washington, D.C. Office of Aviation Medicine.
DEVELOPMENT AND EVALUATION OF A PROTOTYPE LIFE PRESERVER
B. J. Rueschoff, E. A. Higgins, M. J. Burr, and D. M. Branson Sep. 1985 66 p
(AD-A163224; FAA-AM-85-11) Avail: NTIS HC A04/MF A01 CSCL 06/7

The purpose of this study was to develop a prototype life preserver that included provisions for: (1) increased thermal protection in the event of accidental immersion in cold water, (2) 35 pounds of buoyancy, (3) a donning time of 15 s for an adult, (4) not weighing more nor requiring more storage space than currently used life preservers, (5) fitting individuals from the 5th percentile of adult females to the 95th percentile of adult males in the U.S. adult population, and (6) self-righting the wearer in 5 s. Evaluations were made to ensure that the prototype life preserver met goals of items 2 through 6. However, the focus of the study was the assessment of thermal response characteristics. To assess the thermal response of subjects wearing the prototype life preserver and a currently used standard personal flotation device, a laboratory study with 10 subjects was conducted. Two subjects, one wearing the prototype and the other a standard vest, were immersed during each experiment in 12.8 C (55 F) water in the Civil Aeromedical Institute survival tank for 2 hours. Rectal temperature, heart rate, and EKG were measured continuously. Eight of ten subjects, while wearing the prototype life preserver, showed a decrease in the rate of cooling when compared to the cooling rate when wearing the standard vest. GRA

N86-26298# Simula, Inc., Phoenix, Ariz.
CRASH-RESISTANT CREWSEAT LIMIT-LOAD OPTIMIZATION THROUGH DYNAMIC TESTING WITH CADAVERS Final Report, May 1979 - Dec. 1985
J. W. Coltman, C. Van Ingen, and F. Selker Jan. 1986 112 p
(Contract DAAK51-79-C-0016; DA Proj. 1L1-62209-AH-76)
(AD-A164828; TR-85422; USAAVSCOM-TR-85-D-11) Avail: NTIS HC A06/MF A01 CSCL 01/2

The threshold of spinal injury for seated humans subjected to +Gz loading was investigated. The +Gz loading was induced by simulating crash conditions typically found in helicopter crashes, and modified by the use of energy-absorbing mechanisms incorporated in the seat structure. Fifteen tests were conducted with unembalmed cadavers as human surrogates at various limit-load settings to attempt to identify the load threshold causing spinal injury. Bone strength analysis was used to normalize the results of the cadaver test program. Performance data and autopsy results for the 15 crash tests are presented. A correlation was derived relating the frequency of spinal injury to the energy absorber limit-load factor for use in design of crashworthy seating systems. Comparison of the incidence of spinal injury between the experimental test data developed through testing with cadavers and field performance of production energy-absorbing seats is discussed. The report also contains a discussion of the biomechanics

of trauma associated with the human spine, including mechanical properties of the spine, typical injury mechanisms for +Gz loading, and theoretical models for predicting injury. GRA

N86-26299# Coordinating Research Council, Inc., Atlanta, Ga.
FLAMMABILITY OF AIRCRAFT HYDRAULIC FLUIDS: A BIBLIOGRAPHY
Jan. 1986 46 p refs
(Contract DAAK70-86-C-0011)
(AD-A165463; CRC-546) Avail: NTIS HC A03/MF A01 CSCL 11/8

As part of an overall effort to collect flammability data on aircraft fluids, a critical survey was made of the aircraft hydraulic oil literature, with particular emphasis on flammability testing and flammability characteristics of existing and projected aircraft hydraulic fluids. Commercial aviation and military aviation fluids are treated separately, in view of their divergent development. Flammability test procedures are described. Flammability test results and other inspection tests are given for a variety of current and proposed aircraft hydraulic fluids. GRA

N86-26300# Midwest Research Inst., Kansas City, Mo.
EVALUATION OF CHARGED FOG FOR SMOKE CLEARING SHIPBOARD FIRES Final Report, Jul. 1984 - Jul. 1985
John Kinsey and Frank J. Pendleton 12 Jul. 1985 49 p
(Contract N00014-84-C-2189)
(AD-A165551; MRI-8140-L) Avail: NTIS HC A03/MF A01 CSCL 13/12

Accidental fires occurring on-board Navy surface vessels create massive quantities of dense black smoke. To increase visibility and improve firefighting capabilities, appropriate technology is needed for clearing smoke from corridors and passageways. In response to this need, midwest Research Institute has conducted research to evaluate the use of charged water droplets (fog) for clearing smoke from a test chamber under controlled laboratory conditions. As part of this effort, a new type of charged droplet generator (electrostatic fogger) has been developed which is both novel in its approach and unique in design. The results of the study indicate that smoke can be visually cleared from the test chamber within 15 to 60 sec after application of the charged fog, with similar trends observed for particle number concentration. Also, the electrostatic fogger development in the study is superior in many respects to other devices of a similar capacity and, therefore, represents an advancement in charged fog technology. GRA

N86-26301# National Transportation Safety Board, Washington, D. C. Bureau of Safety Programs.
TRANSPORTATION SAFETY RECOMMENDATIONS ADOPTED DURING THE MONTH OF DECEMBER 1985
1986 95 p
(PB85-916612; NTSB-REC-85-12) Avail: NTIS MF A01; also available on subscription, North American Continent price HC $65.00/year; all others write for quote CSCL 01B

The publication contains safety recommendations in aviation, highway and marine modes of transportation adopted by the National Transportation Safety Board during the month of December, 1985. GRA

N86-26302# National Transportation Safety Board, Washington, D. C. Bureau of Technology.
SAFETY REPORT GENERAL AVIATION CRASHWORTHINESS PROJECT. PHASE 3: ACCELERATION LOADS AND VELOCITY CHANGES OF SURVIVABLE GENERAL AVIATION ACCIDENTS Report, 1972 - 1981
4 Sep. 1985 187 p
(PB85-917016; NTSB-SR-85-02) Avail: NTIS MF A01; also available on subscription, North American Continent price HC $60.00/year; all others write for quote CSCL 01C

The report is the last in a series of three reports issued by the National Transportation Safety Board as a result of its General Aviation Crashworthiness Program. The purpose of the program is to provide information to support changes in crashworthiness design standards for seating and restraint systems in general aviation airplanes. A Phase One report presents a methodology for documenting impact severity. A Phase Two report presents specific data on survivable accidents which demonstrate that if all occupants wear shoulder harnesses, fatalities are expected to be reduced by 20 percent. Eighty-eight percent of the seriously injured persons in survivable crashes are expected to experience significantly fewer life-threatening injuries. The Phase Three report provides analytical results of actual crashes. The values of acceleration loads and velocity changes that occupants can sustain in survivable, modern aviation airplane accidents are defined. GRA

N86-26303# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.
AIRCRAFT ACCIDENT REPORTS, BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION ISSUE NUMBER 3 OF 1984 ACCIDENTS
18 Oct. 1985 421 p
(PB85-916922) Avail: NTIS HC A18/MF A01; paper copy also avail. on subscription, North American Continent price $185.00/year; all others write for quote CSCL 01B

Selected aircraft accident reports in brief format occurring in the U.S. civil and foreign aviation operations during calender year 1984 are presented. Approximately 200 general aviation and air carrier accidents contained in the publication represent a random selection. The publication is issued irregularly, normally eighteen times each year. The brief format represent the facts, conditions, circumstances, and probable causes for each accident. GRA

N86-26304# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.
AIRCRAFT ACCIDENT REPORTS, BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION ISSUE NUMBER 4 OF 1984 ACCIDENTS
14 Nov. 1985 416 p
(PB85-916923; NTSB-AAB-85-23) Avail: NTIS HC A18/MF A01; paper copy also available on subscription, North American Continent price $185.00/year; all others write for quote CSCL 01B

This fourth issue contains selected aircraft accident reports in brief format occurring in U.S. civil and foreign aviation operations during calender year 1984. Approximately 200 general aviation and air carrier accidents contained in the publication are selected at random. The publication is issued approximately eighteen times each year at irregular intervals. The brief format contains the facts, conditions, circumstances, and probable cause(s) for each accident. GRA

N86-26305# National Transportation Safety Board, Washington, D. C.
AIRCRAFT ACCIDENT REPORTS, BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION ISSUE NUMBER 5 OF 1984 ACCIDENTS
24 Jan. 1986 418 p
(PB86-916901; NTSB-AAB-86-01) Avail: NTIS HC A03/MF A01; paper copy also avail. on subscription, North American Continent price $185.00/year; all others write for quote CSCL 01B

The publication contains selected aircraft accident reports in Brief Format occurring in U.S. civil and foreign aviation operations during Calendar Year 1984. Approximately 200 General Aviation and Air Carrier accidents contained in the publication represent a random selection. The publication is issued irregularly, normally eighteen times each year. The Brief Format represents the facts, conditions, circumstances and probable causes(s) for each accident. Issue 5 includes file numbers 801 through 1000. GRA

N86-26306# National Transportation Safety Board, Washington, D. C.
AIRCRAFT ACCIDENT REPORTS, BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION ISSUE NUMBER 6 OF 1984 ACCIDENTS
24 Jan. 1986 418 p
(PB86-916902; NTSB-AAB-86-02) Avail: NTIS HC A18/MF A01;

paper copy also avail. on subscription, North American Continent price $185.00/year; all others write for quote CSCL 01B

The publication contains selected aircraft accident reports in Brief Format occurring in U.S. civil and foreign aviation operations during Calendar Year 1984. Approximately 200 General Aviation and Air Carrier accidents contained in the publication represent a random selection. The publication is issued irregularly, normally eighteen times each year. The Brief Format represents the facts, conditions, circumstances and probable cause(s) for each accident. Issue 6 includes file numbers 1001 through 1200. GRA

N86-26307# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.
AIRCRAFT ACCIDENT REPORTS, BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION ISSUE NUMBER 7 OF 1984 ACCIDENTS
22 Nov. 1985 421 p
(PB86-916903; NTSB-AAB-86-03) Avail: NTIS HC A18/MF A01; paper copy also avail. on subscription, North America Continent price $185.00/year; all others write for quote CSCL 01B

The publication contains selected aircraft accident reports in Brief Format occurring in U.S. civil and foreign aviation operations during Calendar Year 1984. Approximately 200 General Aviation and Air Carrier accidents contained in the publication represent a random selection. The publication is issued irregularly, normally eighteen times each year. The Brief Format represents the facts, conditions, circumstances and probable cause(s) for each accident. Issue 7 includes file numbers 1201 through 1400. GRA

N86-26308# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.
AIRCRAFT ACCIDENT REPORTS, BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION ISSUE NUMBER 8 OF 1984 ACCIDENTS
22 Nov. 1985 421 p
(PB86-916904; NTSB-AAB-86-04) Avail: NTIS HC A18/MF A01; paper copy also avail. on subscription, North American Continent price $185.00/year; all others write for quote CSCL 01B

The publication contains selected aircraft accident reports in Brief Format occurring in U.S. civil and foreign aviation operations during Calendar Year 1984. Approximately 200 General Aviation and Air Carrier accidents contained in the publication represent a random selection. The publication is issued irregularly, normally eighteen times each year. The Brief Format represents the facts, conditions, circumstances and probable cause(s) for each accident. Issue 8 includes file numbers 1401 through 1600. GRA

N86-26309# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.
AIRCRAFT ACCIDENT REPORTS, BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION ISSUE NUMBER 9 OF 1984 ACCIDENTS
29 Nov. 1985 400 p
(PB86-916905; NTSB-AAB-86-05) Avail: NTIS HC A17/MF A01; paper copy also avail. on subscription, North American Continent price $185.00/year; all others write for quote CSCL 01B

The publication contains selected aircraft accident reports in brief format occurring in U.S. civil and foreign aviation operations during calendar year 1984. Approximately 200 general aviation and air carrier accidents contained in the publication represent a random selection. The publication is issued irregularly, normally eighteen times each year. The brief format represents the facts, conditions, circumstances and probable cause(s) for each accident. Issue 9 includes file numbers 1601 through 1800. GRA

N86-26310# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.
AIRCRAFT ACCIDENT REPORTS, BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION ISSUE NUMBER 11 OF 1984 ACCIDENTS
16 Dec. 1985 418 p
(PB86-916907; NTSB-AAB-86-07) Avail: NTIS HC A18/MF A01; also avail. on subscription, North American Continent price $185.00/year; all others write for quote CSCL 01B

The publication contains selected aircraft accident reports in Brief Format occurring in U.S. civil and foreign aviation operations during Calendar Year 1984. Approximately 200 General Aviation and Air Carrier accidents contained in the publication represent a random selection. The publication is issued irregularly, normally eighteen times a year. The Brief Format represents the facts, conditions, circumstances and probable cause(s) for each accident. Issue 11 includes file numbers 2001 through 2200. GRA

N86-26311# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.
AIRCRAFT ACCIDENT REPORTS, BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION ISSUE NUMBER 13 OF 1984 ACCIDENTS
30 Dec. 1985 412 p
(PB86-916909; NTSB-AAB-86-09) Avail: NTIS HC A18/MF A01; also avail. on subscription, North American Continent price $185.00/year; all others write for quote CSCL 01B

The publication contains selected aircraft accident reports in Brief Format occurring in U.S. civil and foreign aviation operations during Calendar Year 1984. Approximately 200 General Aviation and Air Carrier accidents contained in the publication represent a random selection. The publication is issued irregularly, normally eighteen times each year. The Brief Format represents the facts, conditions, circumstances and probable cause(s) for each accident. Issue 13 includes file numbers 2401 through 2600. GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications.*

N86-26312*# Princeton Univ., N. J. Dept. of Civil Engineering.
INTEGRATED RISK/COST PLANNING MODELS FOR THE US AIR TRAFFIC SYSTEM
John M. Mulvey and Stavros A. Zenios Dec. 1985 41 p refs
(Grants NAG1-520; NSF DCR-84-01098)
(NASA-CR-177274; NAS 1.26:177274; EES-85-9) Avail: NTIS HC A03/MF A01 CSCL 17G

A prototype network planning model for the U.S. Air Traffic control system is described. The model encompasses the dual objectives of managing collision risks and transportation costs where traffic flows can be related to these objectives. The underlying structure is a network graph with nonseparable convex costs; the model is solved efficiently by capitalizing on its intrinsic characteristics. Two specialized algorithms for solving the resulting problems are described: (1) truncated Newton, and (2) simplicial decomposition. The feasibility of the approach is demonstrated using data collected from a control center in the Midwest. Computational results with different computer systems are presented, including a vector supercomputer (CRAY-XMP). The risk/cost model has two primary uses: (1) as a strategic planning tool using aggregate flight information, and (2) as an integrated operational system for forecasting congestion and monitoring (controlling) flow throughout the U.S. In the latter case, access to a supercomputer is required due to the model's enormous size.
Author

N86-26313# Pacific Missile Test Center, Point Mugu, Calif.
NAVSTAR GPS (GLOBAL POSITIONING SYSTEM) ACCURACY WHILE SURVEYING ARRAYS OF DEEP OCEAN TRANSPONDERS
Larry A. Anderson Dec. 1985 21 p
(AD-A163364; PMTC-TP-000037) Avail: NTIS HC A02/MF A01 CSCL 17/7

The observed accuracy of the Navstar GPS Global Positioning System when used with acoustic data to geodetically locate arrays of bottom-mounted ocean transponders is presented. Two arrays were to be located, and each was surveyed on several separate occasions. In addition to GPS with dual frequency precise P-code, the arrays were located by using Argo, Syledis, Transit satellites, and by several other tracking methods. Because the array positions have been well determined, the data is now able to reveal the absolute GPS fix error while at sea. For one survey, ground truth information from the Yuma GPS facility, 263 nautical miles (487 km) away, was used to reduce measurement bias.
GRA

N86-26314# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
NAVIGATION EQUIPMENT, DOPPLER Final Report
1 Aug. 1985 31 p Supersedes MTP-6-2-206
(AD-A163408; TOP-6-2-206; MTP-6-2-206) Avail: NTIS HC A03/MF A01 CSCL 17/7

This Test Operations Procedure describes test methods and techniques for evaluating Doppler Navigation Equipment and Systems and their Suitability for employment in the intended tactical environment.
GRA

N86-26315# Federal Aviation Agency, Atlantic City, N.J.
MATH MODEL STUDY OF A PROPOSED GLIDE SLOPE FOR RUNWAY 13R, DALLAS-FORT WORTH AIRPORT, TEXAS
John Walls Jan. 1986 19 p refs
(AD-A164907; DOT/FAA/CT-TN85/80) Avail: NTIS HC A02/MF A01 CSCL 01/5

This document describes instrument landing system (ILS) math modeling performed at the request of the Southwest Region. Data are presented showing the computed performance of a proposed glide slope for runway 13R at the Dallas-Fort Worth Airport, Texas. Model path structure and level run plots are provided for capture effect, null reference, and sideband reference systems installed at a location selected by region engineers. Results indicate that all three systems should meet category II path structure, linearity, and symmetry tolerances. The capture effect system provides the smoothest glidepath structure of the three systems modeled.
Author (GRA)

N86-26316# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Guidance and Control Panel.
GUIDANCE-CONTROL-NAVIGATION AUTOMATION FOR NIGHT ALL-WEATHER TACTICAL OPERATIONS
Loughton, England Oct. 1985 136 p refs In ENGLISH and FRENCH The 40th Guidance and Control Panel Symposium was held at The Hague, Netherlands, 21-24 May 1985
(AGARD-CP-387; ISBN-92-835-0381-3) Avail: NTIS HC A07/MF A01

The components, functions, and systems integration required to support the evolution of alternative guidance/control/navigation systems capable of enabling effective and routine night all-weather operations are discussed. Papers are organized under the following headings: operational requirements, systems concepts and integration issues, man-machine interface, terrain reference systems, and mission applications. For individual titles, see N86-26317 through N86-26327.

N86-26317# Marconi Avionics Ltd., Rochester (England).
A COST-EFFECTIVE NIGHT ATTACK SYSTEM FOR GROUND ATTACK AIRCRAFT
J. F. Fisher and G. R. Sleight *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 8 p (For primary document see N86-26316 17-04)
Avail: NTIS HC A07/MF A01

Current ground attack fighters have a good day visual flight rule (VFR) capability. However, they are generally ineffective at night. GEC Avionics have developed a simple integrated night vision system which allows a pilot to operate effectively at high speed and low level. The system uses a fixed forward-looking FLIR sensor to display imagery to the pilot on a raster head-up display. This allows him to terrain-follow and acquire targets. He then uses a touch-sensitive head down display to designate targets to his weapon system for subsequent attack. The pilot is also equipped with night vision goggles to permit hard maneuvering, and with a digital map to enable him to navigate flexibly. By designing the entire system as an integrated whole, cockpit workload is minimized. A series of flight trials has clearly proved the concept. The US Marine Corps AV-8B and RAF Harrier GR5 will soon be equipped with just such a system.
Author

N86-26318# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
COCKPIT AUTOMATION REQUIREMENTS DERIVED FROM MISSION FUNCTIONS DATA c54
Bernadette Faulkner, R. Seifert, and K. D. Richter *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 7 p refs (For primary document see N86-26316 17-04)
Avail: NTIS HC A07/MF A01

Program activities directed towards the development of a system engineering concept for the design of the man-machine interface are summarized. The problem was approached from an operational and human task point of view. The first phase included the development of: (1) a mission task list for selected mission and weapon systems; (2) a method for rating the relative importance of each of the tasks related (a) to the frequency of occurrence, (b) to mission effectiveness, and (c) to flight safety; (3) criteria and/or categories for automation at the man-machine interface, against which the individual mission tasks could be rated; and (4) a method for rating the missien tasks in relation to the automation categories derived.
Author

N86-26319# Ferranti Defence Systems Ltd., Edinburgh (Scotland).
AUTOMATION AND PILOT INTERACTIONS IN NIGHT OR ALL-WEATHER TACTICAL OPERATIONS c54
W. H. McKinlay *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 10 p (For primary document see N86-26316 17-04)
Avail: NTIS HC A07/MF A01

Some of the areas in which automation could be used to reduce pilot workload when operating at night or in low visibility are examined. It is shown that in navigation the pilot's task extends from the planning stage before take off to the point at which tactical decisions are taken in the air. The role of the mission planning system and the features of a system developed for this purpose are covered. The nature of the man-machine interface including its required features and the impact of the latter on the core avionic system including navigation and the MMI are addressed.
Author

N86-26320# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Human Engineering Div.
SOME QUANTITATIVE METHODOLOGY FOR COCKPIT DESIGN c05
Charles Bates, Jr. and Maris M. Vikmania *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 10 p refs (For primary document see N86-26316 17-04)
Avail: NTIS HC A07/MF A01

The rapidly developing technology in sensor systems, microprocessors, artificial intelligence and communication systems has blurred the traditional lines between avionics subsystems and offers new design options for integrating the aircrew into the weapon system. These developments, together with the stressful flight regimes imposed by advanced threat systems and the night-in-weather environment required for survival in air-to-ground attack/interdiction, require new approaches to crew station design. These new design opportunities are limited only by the design tools and data bases available for their execution. A simplified cockpit design process can be summarized as conceptual design, detailed design, and design verification. With the many tools needed to pursue this process the subset involving man/machine interface must

provide a decision track quantifying and predicting the impact of design decisions on crew performance. To meet the objective of the full utilization of the weapon system crew, each technology option under consideration for incorporation in the cockpit must be judged with consideration of both mission and human performance. The cockpit design process must be embedded in an adequate human performance data base tailored for use by design personnel and must take full advantage of operational experience. The development of a family of cockpit design tools, together with the required data bases, has been one of the objectives of the Air Force Aerospace Medical Research Laboratory research program. From this program a select set of methods will be described and examples provided. Author

N86-26321# Thomson-CSF, Issy les Moulineaux (France).
SYNTHETIC REAL-TIME RELIEF DISPLAY ALL-WEATHER AIRBORNE MISSIONS **c06**
J. N. Botella *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 4 p (For primary document see N86-26316 17-04)
Avail: NTIS HC A07/MF A01

Within the context of all-weather airborne missions, it is necessary to provide the pilot with information on the external world, even, and particularly when information provided by radar or optronic sensors are failing. The development of altimetric digital data banks prompts investigations to examine the display of synthetic relief in a cockpit. The study of various mass storages shows that a color film has remarkable storage capacities. Altimetric data are stored on a film read by the MERCATOR reader (whose initial function is to read map images). Three-dimensional synthesis algorithms are used and they are provided with the exceptional possibilities enabled by the MERCATOR analysis. The philosophy of this study is to show how a unique product, the map reader MERCATOR, designed to display plane images, is used to perform tridimensional displays of relief. Author

N86-26322# Farrand Optical Co., Inc., Valhalla, N.Y.
THE WIDE FIELD HELMET MOUNTED DISPLAY **c06**
Joseph LaRussa *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 7 p refs (For primary document see N86-26316 17-04)
Avail: NTIS HC A07/MF A01

The wide field helmet mounted display developed by the Farrand Optical Company, Inc. is described. This display provides the pilot with an instantaneous field of view of 60 deg vertically and 135 deg horizontally. The central field of view consists of an overlap field of 25 deg within which full stereopsis is available. It would appear that a new design which the Farrand Optical Company, Inc. is now in the process of designing for Aerospace Medical Research Laboratory (AMRK) would be applicable for night all weather operations where such data as flight path control, computed weapon projectories, synthetic outside world views, expected and unexpected threats and automatic terrain following paths would be displayed. The parameters that must be considered in designing a wide field helmet mounted display are discussed. Briefly, these parameters are size, weight and balance on the head, brightness of the display and see-through ability of the display. The discussion assumes the use of a one inch, high brightness, high resolution CRT input already developed and operational. Author

N86-26323# Marconi Avionics Ltd., Rochester (England). Aircraft and Missile Systems.
A SOLID-STATE MAP DISPLAY FOR RAPID RESPONSE OPERATION **c06**
D. J. Powell and T. E. Crayford *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 13 p (For primary document see N86-26316 17-04)
Avail: NTIS HC A07/MF A01

A means to provide pilots with a presentation of a moving color map display on a standard color CRT is described. It uses solid-state techniques and derives the display from a digital database. The design criteria used in the development of the system are discussed and an overview of the system operation is presented. Finally, one of the many ways in which the system as a whole may be used in operation is addressed. Author

N86-26324# Harris Government Aerospace Systems Div., Melbourne, Fla. Digital Cartographic Programs.
APPLICATIONS OF DIGITAL TERRAIN DATA IN FLIGHT OPERATIONS
G. W. Cantrell *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 24 p (For primary document see N86-26316 17-04)
Avail: NTIS HC A07/MF A01

With the availability of a world-wide digital terrain data base becoming a reality, it is now possible to carry and display on a tactical aircraft all of the map information needed for a mission. Along with the map display on a color cathode-ray tube (CRT), current targets and mission-specific data can be shown. The limitations of today's commonly used film readers are eliminated by using a digital data base which contains elevation information; one such data base is the U.S. Defense Mapping Agency's Digital Land Mass System (DLMS). The terrain data can be digitally compressed and efficiently stored so that large area coverages may be achieved. With this information readily available, aircraft mission effectiveness and survivability can be enhanced. The system for accomplishing this task is called a digital map generator (DMG). The DMG architecture encompasses data storage, data access and reconstruction, data display processing, and data formatting for use by other aircraft subsystems. A DMG architecture was developed for application in low-level or nap-of-the-Earth tactical missions, as well as long range strategic missions. Mission capabilities are enhanced by using this DMG to support terrain following/terrain avoidance (TF/TA), autonomous navigation, threat avoidance, and weapons delivery. In addition, the same digital processing approach is usable for pre-flight mission planning. The ability to plan a flight using the actual mission data base gives the pilot the ability to see exactly where he will be at all times and to determine safe corridors for entry and departure, making maximum use of terrain shielding. Similarly, the terrain data may be used for reference during post-mission debriefing, in which the pilot can refer to in-flight annotations made through the DMG subsystem. Author

N86-26325# Theory and Applications Unlimited Corp., Los Gatos, Calif.
A NEW TECHNIQUE FOR TERRAIN FOLLOWING/TERRAIN AVOIDANCE GUIDANCE COMMAND GENERATION
Richard V. Denton, J. Edwin Jones, and Peter L. Froeberg *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 11 p refs (For primary document see N86-26316 17-04)
Avail: NTIS HC A07/MF A01

A real-time optimization technique that efficiently generates a robust, optimum terrain following/terrain avoidance (TF/TA) trajectory, and has the structural capability for adding threat avoidance is described. The TF/TA technique presented is based on definition of a performance measure that is systematically optimized in real-time. The approach uses on-board Defense Mapping Agency digital terrain elevation data extensively, as updated by real-time sensor inputs. The optimization of the performance measure embodies the real-time trade-off of flying over (TF) versus flying around terrain features (TA). The performance measure is defined to generally penalize large excursions from the nominal (globally-defined) route, while rewarding a trajectory that achieves better terrain masking than contained in the nominal, mission-planned route. Direct incorporation of limits on the flight control variables (bank angle, roll rate, normal acceleration, etc.) is included within the procedure. The TF/TA technique also addresses additional considerations that apply when combining the TF/TA flight trajectory computation with maneuvers through mission waypoints. This involves several subtleties associated with the relative importance of the turning maneuver desired versus the normally applicable TF/TA performance measure. Finally, the relevance of this work to other advances in

trajectory computation is described. This includes the relationship to global trajectory generation, and to integrated TF/TA with threat avoidance TF/(TA)2. Author

N86-26326# Societe Francaise d'Instruments de Mesure, Velizy-Villacoublay (France). Secteur Capteur Optronique.
USE OF A CO2 LASER LIDAR FOR FLIGHT AND PENETRATION AT VERY LOW ALTITUDES [UTILISATION D'UN LIDAR A LASER CO2 POUR LE VOL ET LA PENETRATION A TRES BASSE ALTITUDE] c36
Bernard Stephan *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 8 p (For primary document see N86-26316 17-04)
Avail: NTIS HC A07/MF A01

A CO2 laser optical sensor system which allows the acquisition of accurate land distances for a large area is described. These values are obtained in a real-time mode with the use of a UMP 7800 computer, and allow the generation of a map of the terrain to determine geographic coordinates. This map makes it possible to determine the optimal navigation trajectory at very low altitudes, with optimization based on the terrain features. This sensor was tested at Villacoublay in 1984 and is currently under testing at C.E.V. The results of the experiments and the static and dynamic analysis tests are presented. Transl. by T.R.

N86-26327# Crouzet Aerospace and Systems, Valence (France). Div. Aerospatiale.
A MISSION NAVIGATION AND CONTROL SYSTEM FOR MODERN MILITARY HELICOPTERS [UN SYSTEME DE NAVIGATION ET DE GESTION DE LA MISSION POUR LES HELICOPTERS MILITAIRES MODERNES]
J. L. Roch *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 10 p In FRENCH (For primary document see N86-26316 17-04)
Avail: NTIS HC A07/MF A01

The requirements of modern military helicopters have fostered the development of navigation systems which use position sensors as a part of a centralized mission control system. An overview of the requirements for modern operational helicopter systems is given, as well as current automatic navigation systems; this is followed by a report of the NADIR MK2 mission navigation and control system developed by the CROUZET Company. Transl. by T.R.

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.*

N86-26328*# National Aeronautics and Space Administration. Dryden (Hugh L.) Flight Research Center, Edwards, Calif.
X-29A TECHNOLOGY DEMONSTRATOR FLIGHT TEST PROGRAM OVERVIEW
Walter J. Sefic and Cleo M. Maxwell May 1986 17 p refs Presented at the ISA Aerospace Industries/Test Measurement Symposium, Seattle, Wash., 5-8 May 1986
(NASA-TM-86809; H-1347; NAS 1.15:86809; ISA-504) Avail: NTIS HC A02/MF A01 CSCL 01C

An overview of the X-29A functional flight program and concept evaluation program is presented, including some of the unique and different preparations for the first flight. Included are a discussion of the many organizational responsibilities and a description of the program management structure for the test team. Also discussed are preflight ground, flight functional envelope expansion, and flight research test objectives and qualitive results to date for both a limited-envelope flight control system and an expanded-envelope system. The aircraft, including the instrumentation system and measurements, is described. In addition, a discussion is included regarding the use of major support facilities, such as ground and flight simulators, the NASA Western Aeronautical Test Range and mission control center, and the Grumman automated telemetry station. An overview of the associated real-time and postflight batch data processing software approaches is presented. The use of hardware-in-the-loop simulation for independent verification and validation and mission planning and practice is discussed. Also included is a description of the flight-readiness review, the airworthiness and flight safety review, work scheduling, technical briefings, and preflight and postflight crew briefings. The configuration control process used on the X-29A program is described, and its relationship to both simulation and aircraft operations is discussed. An X-29A schedule overview is presented with an outline of a proposed follow-on program. Author

N86-26329# Federal Aviation Administration, Washington, D.C.
FLIGHT TEST GUIDE FOR CERTIFICATION OF TRANSPORT CATEGORY AIRPLANES
9 Apr. 1986 96 p
(FAA-AC-25-7) Avail: NTIS HC A05/MF A01

These flight test requirement guidelines provide an acceptable means of demonstrating compliance with the applicable airworthiness requirements. Controllability and maneuverability; stability; stalls; ground and water handling characteristics; vibration and buffeting; high speed performance; takeoff and landing; weight and load distribution limits; and propeller speed and pitch limits are discussed. B.G.

N86-26330*# Wichita State Univ., Kans. Dept. of Aeronautical Engineering.
THEORETICAL ANALYSIS OF THE ELECTRICAL ASPECTS OF THE BASIC ELECTRO-IMPULSE PROBLEM IN AIRCRAFT DE-ICING APPLICATIONS
Robert A. Henderson and Robert L. Schrag Jun. 1986 108 p refs
(Grant NAG3-284)
(NASA-CR-176808; NAS 1.26:176808; AR-86-2) Avail: NTIS HC A06/MF A01 CSCL 01C

A summary of modeling the electrical system aspects of a coil and metal target configuration resembling a practical electro-impulse deicing (EIDI) installation, and a simple circuit for providing energy to the coil, was presented. The model was developed in sufficient theoretical detail to allow the generation of computer algorithms for the current in the coil, the magnetic induction on both surfaces of the target, the force between the coil and target, and the impulse delivered to the target. These algorithms were applied to a specific prototype EIDI test system for which the current, magnetic fields near the target surfaces, and impulse were previously measured. Author

N86-26331*# Textron Bell Helicopter, Fort Worth, Tex.
SIX DEGREE-OF-FREEDOM LIVE ISOLATION SYSTEMS, PART 1 Interim Report
Dennis R. Halwes and Colby O. Nicks Apr. 1986 79 p
(Contract NAS1-16969)
(NASA-CR-177928; NAS 1.26:177928) Avail: NTIS HC A05/MF A01 CSCL 01C

A Total Main Rotor Isolation System (TRIS) was analyzed, designed, fabricated, and bench tested for the reduction of main rotor vibration levels transmitted to the helicopter fuselage. The TRIS consists of a six degree-of-freedom passive system using six Liquid Inertia Vibration Eliminator (LIVE) units developed by Bell Helicopter Textron. The objective of the program is to develop a helicopter isolation system that will achieve 90% (or greater) isolation at minimum weight with no degradation in vehicle stability, handling qualities, alignment tolerance, and reliability or maintainability. Author

N86-26332# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AIRCRAFT NUCLEAR SURVIVABILITY METHODS Ph.D. Thesis
Halvor A. Undem Sep. 1985 279 p
(AD-A163218; AFIT/DS/PH/84-3) Avail: NTIS HC A13/MF A01

CSCL 18/3

A new approach for assessing the survivability of aircraft components in nuclear blast and thermal environments is presented in this dissertation. A nonparametric technique is developed for use in calculating the reliability interference integral. This approach eliminates the need for density function identification and parameter estimation. Furthermore, the method can be used without resorting to large-sample random Monte Carlo simulation or propagation of moments. In addition to this, the derived cumulative distribution function using such a technique exactly interpolates the true distribution function at selected points. The method is applied to the problem of aircraft survivability in nuclear blast environments using failure (strength) distributions found in the literature. It is also applied to the case of aircraft survivability in nuclear thermal environments where direct failure data is not available. Inputs to the engineering models involved are treated statistically and the method is used to rigorously determine the statistical nature of the output variables. GRA

N86-26333# General Accounting Office, Washington, D. C. National Security and International Affairs Div.

AQUILA REMOTELY PILOTED VEHICLE: RECENT DEVELOPMENTS AND ALTERNATIVES

Jan. 1986 14 p refs

(AD-A164597; GAO/NSIAD-86-41BR) Avail: NTIS HC A02/MF A01 CSCL 01/3

This GAO report is about the Army's Aquila Remotely Piloted Vehicle (RPV), which has had numerous difficulties since it entered full-scale development in 1979. Among these have been technical performance problems and funding cuts, which have led to substantial cost growth and schedule slippage. During the past year, the emergence of critical performance problems during testing led to a major program restructuring and threatened the Aquila's future. Prior to these changes, costs to acquire the Aquila were estimated at about $2 billion. This estimate has not yet been revised to reflect the recent changes. Several RPV systems exist in addition to the Aquila. The Army considered these alternative systems in a study it made in 1984 from the standpoint of their possible availability and potential to perform in the stringent environment envisioned for Aquila's use. GAO found that although the study did not consider several factors which could have led to a more balanced comparison, the Army chose to continue the Aquila development because of its earlier availability. GRA

N86-26334# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

AIRCRAFT PERFORMANCE OPTIMIZATION WITH THRUST VECTOR CONTROL M.S. Thesis

Mark S. Fellows Dec. 1985 132 p

(AD-A165388; AFIT/GAE/AA/85D-6) Avail: NTIS HC A07/MF A01 CSCL 01/2

The objective of this thesis is to determine to what extent a highly-maneuverable aircraft's overall performance capability is enhanced by thrust-vectoring nozzles. The resulting performance capabilities are compared to a baseline configuration with non-thrust-vectoring nozzles to determine the effects and advantages of thrust vectoring. The results indicate that the use of vectored thrust can significantly increase an aircraft's performance capability in turning flight. The greater the demand on the aircraft in a turning combat scenario, the more the aircraft utilizes its thrust-vectoring capability to complete the task. The results also indicate that the use of vectored thrust in other phases of flight -- such as cruise, acceleration and climb -- only slightly increases an aircraft's performance capability. GRA

N86-26320# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Human Engineering Div.

SOME QUANTITATIVE METHODOLOGY FOR COCKPIT DESIGN

Charles Bates, Jr. and Maris M. Vikmania *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 10 p refs (For primary document see N86-26316 17-04)

Avail: NTIS HC A07/MF A01

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N86-26335# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

METHOD FOR DETERMINING THE TIME DELAY OF THE PITOT-STATIC TUBING SYSTEM OF AIRCRAFT

J. H. Breeman 17 Jun. 1985 19 p

(NLR-TR-83075-U; ESA-86-96978) Avail: NTIS HC A02/MF A01

The measurement of the response of the pitot-static tubing system of aircraft is described. A small jet transport is used as an example. Results of measurements performed on the ground and at an altitude of 3000 ft are reported. ESA

N86-26321# Thomson-CSF, Issy les Moulineaux (France).

SYNTHETIC REAL-TIME RELIEF DISPLAY ALL-WEATHER AIRBORNE MISSIONS

J. N. Botella *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 4 p (For primary document see N86-26316 17-04)

Avail: NTIS HC A07/MF A01

N86-26322# Farrand Optical Co., Inc., Valhalla, N.Y.

THE WIDE FIELD HELMET MOUNTED DISPLAY

Joseph LaRussa *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 7 p refs (For primary document see N86-26316 17-04)

Avail: NTIS HC A07/MF A01

N86-26323# Marconi Avionics Ltd., Rochester (England). Aircraft and Missile Systems.

A SOLID-STATE MAP DISPLAY FOR RAPID RESPONSE OPERATION

D. J. Powell and T. E. Crayford *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 13 p (For primary document see N86-26316 17-04)

Avail: NTIS HC A07/MF A01

N86-26806# Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris (France).

EVALUATION OF HELICOPTER HELMET-MOUNTED DISPLAY MOCK-UP

Guy Santucci and Claude Valot *In* AGARD Visual Protection and Enhancement Dec. 1985 14 p refs (For primary document see N86-26802 17-52)

Avail: NTIS HC A11/MF A01

N86-26809# Army Aeromedical Research Lab., Fort Rucker, Ala.

MICRO-HEADS-UP DISPLAY FOR ENHANCEMENT OF NIGHT VISION GOGGLE OPERATIONS

R. Simmons, K. Kimball, and B. Hamilton *In* AGARD Visual Protection and Enhancement Dec. 1985 9 p refs (For primary document see N86-26802 17-52)

Avail: NTIS HC A11/MF A01

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N86-26336*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUMMARY OF INVESTIGATIONS OF ENGINE RESPONSE TO DISTORTED INLET CONDITIONS
Thomas J. Biesiadny, Willis M. Braithwaite, Ronald H. Soeder, and Mahmood Abdelwahab 1986 34 p refs Proposed for presentation at the 68th Meeting of the Propulsion and Energetics Panel, Munich, West Germany, 8-9 Sep. 1986; sponsored by AGARD
(NASA-TM-87317; E-3048; NAS 1.15:87317) Avail: NTIS HC A03/MF A01 CSCL 21E

A survey is presented of experimental and analytical experience of the NASA Lewis Research Center in engine response to inlet temperature and pressure distortions. This includes a description of the hardware and techniques employed, and a summary of the highlights of experimental investigations and analytical modeling. Distortion devices successfully simulated inlet distortion, and knowledge was gained about compression system response to different types of distortion. A list of NASA research references is included. Author

N86-26337# Aeronautical Research Labs., Melbourne (Australia).
INVESTIGATION OF BLADE VIBRATION T55-L-11C COMPRESSOR STAGES 1 AND 2
N. S. Swansson 2 Jul. 1986 25 p refs
(AR-004-046; ARL-AERO-Prop-R-168) Avail: NTIS HC A02/MF A01

A vibratory survey of the first and second stage compressor blades on the T55-L-11C engine was conducted following the warning of the manufacturer that the proposed fitting of locally designed intake screens might lead to blade vibration problems. Vibration tests and a simple analysis indicated a possible resonance region. Special statistical methods for small samples were used to fully define tolerance limits for this region and establish confidence levels in the limits. Operators were initially advised to restrict operation in the potential resonance region. Subsequent intake flow tests demonstrated that the screens generated no abnormal excitation, so the restrictions could be discontinued. Author

N86-26338# Aeronautical Research Labs., Melbourne (Australia).
THE GENERAL ELECTRIC F404 - ENGINE OF THE RAAF'S NEW FIGHTER
Denis Frith Jul. 1985 55 p refs
(AD-A164562; ARL-AERO-PROP-TM-426) Avail: NTIS HC A04/MF A01 CSCL 21/5

The F404 engine in the F/A-18 is representative of a new generation of military turbofan engines. The features of the engine that govern its performance and contribute to its maintainability are discussed. The intention is to give the non-specialist an appreciation of those factors materially affecting the operation of this type of engine. The RAAF F/A-18 Hornets are powered by two General Electric F404-GE-400 augmented turbofan engines. The 3-stage fan, driven by the low-pressure turbine, compresses inlet air that subsequently divides into the bypass and core flows. Variable inlet guide vanes schedule the direction of the flow into the fan as a function of rotational speed. The core flow is further compressed for entry to the annular combustor by the compressor, driven by the high-pressure turbine. Variable inlet guide and two rows of stators adjust the flow direction as a function of corrected compressor speed. After expansion through the turbines, the high temperature gas from the combustion process is mixed with the bypass air to form the high speed jet out of the exhaust nozzle. When operating in afterburning mode, the speed of this jet is increased by additional combustion in the afterburner. GRA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N86-26339*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DECOUPLING CONTROL SYNTHESIS FOR AN OBLIQUE-WING AIRCRAFT
Gurbux S. Alag (University of Western Michigan, Kalamazoo), Robert W. Kempel, and Joseph W. Pahle Jun. 1986 12 p refs Presented at the American Control Conference, Seattle, Wash., 18-20 Jun. 1986
(NASA-TM-86801; H-1339; NAS 1.15:86801) Avail: NTIS HC A02/MF A01 CSCL 01C

Interest in oblique-wing aircraft has surfaced periodically since the 1940's. This concept offers some substantial aerodynamic performance advantages but also has significant aerodynamic and inertial cross-coupling between the aircraft longitudinal and lateral-directional axes. This paper presents a technique for synthesizing a decoupling controller while providing the desired stability augmentation. The proposed synthesis procedure uses the concept of a real model-following control system. Feedforward gains are selected on the assumption that perfect model-following conditions are satisfied. The feedback gains are obtained by using eigensystem assignment, and the aircraft is stabilized by using partial state feedback. The effectiveness of the control laws developed in achieving the desired decoupling is illustrated by application to linearized equations of motion of an oblique-wing aircraft for a given flight condition. Author

N86-26340*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AEROELASTIC CONTROL OF OBLIQUE-WING AIRCRAFT
John J. Burken, Gurbux S. Alag, and Glenn B. Gilyard (University of Western Michigan, Kalamazoo) Jun. 1986 12 p refs Presented at the American Control Conference, Seattle, Wash., 18-20 Jun. 1986
(NASA-TM-86808; H-1346; NAS 1.15:86808) Avail: NTIS HC A02/MF A01 CSCL 01B

The U.S. Navy and NASA are currently involved in the design and development of an unsymmetric-skew-wing aircraft capable of 65 deg wing sweep and flight at Mach 1.6. A generic skew-wing aircraft model was developed for 45 deg wing skew at a flight condition of Mach 0.70 and 3048 m altitude. At this flight condition the aircraft has a wing flutter mode. An active implementable control law was developed using the linear quadratic Gaussian design technique. A method of modal residualization was used to reduce the order of the controller used for flutter suppression. Author

N86-26341*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
VALIDATION OF A NEW FLYING QUALITY CRITERION FOR THE LANDING TASK
Donald T. Berry and Shahan K. Sarrafian 1986 10 p Presented at the AIAA Atmospheric Flight Mechanics Conference, Williamsburg, Va., 18-20 Aug. 1986
(NASA-TM-88261; H-1357; NAS 1.15:88261; AIAA-86-2126-CP) Avail: NTIS HC A02/MF A01 CSCL 01C

A strong correlation has been found to exist between flight path angle peak overshoot and pilot ratings for the landing task. The use of flightpath overshoot as a flying quality metric for landing is validated by correlation with four different in-flight simulation programs and a ground simulation study. Configurations tested were primarily medium-weight generic transports. As a result of

good correlation with this extensive data base, criterion boundaries are proposed for landing based on the flight path peak overshoot metric. Author

N86-26342*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
STUDY ON USING A DIGITAL RIDE QUALITY AUGMENTATION SYSTEM TO TRIM AN ENGINE-OUT IN A CESSNA 402B
Kent E. Donaldson 1986 37 p refs
(Grant NAG1-345)
(NASA-CR-177272; NAS 1.26:177272; KU-FRL-6132-3) Avail: NTIS HC A03/MF A01 CSCL 01C

A linear model of the Cessna 402B was used to determine if the control power available to a Ride Quality Augmentation System was adequate to trim an engine-out. Two simulations were completed: one using a steady state model, and the other using a state matrix model. The amount of rudder available was not sufficient in all cases to completely trim the airplane, but it was enough to give the pilot valuable reaction time. The system would be an added measure of safety for only a relatively small amount of development. Author

N86-26343# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
FAILURES IN ADVANCED FLIGHT CONTROL SYSTEMS OF FUTURE TRANSPORT AIRCRAFT
M. F. C. vanGool and W. W. Rickard (McDonnell-Douglas Corp., Long Beach, Calif.) 12 Nov. 1984 187 p refs
(Contracts NIVR-1745; RB-RLD-84/83-1.3.1)
(NLR-TR-84108-U; ESA-86-96983) Avail: NTIS HC A09/MF A01

Failure probability and the effects of flight control system failures on handling qualities of a medium-weight transport with reduced stability equipped with a side-stick controlled fly-by-wire flight control system were studied in a flight simulator. A very simple electrical back-up system was used to reduce the pitch divergence when the primary flight control system failed. Results indicate that a large variability in pilot ratings can occur in this kind of investigation. However, analysis of the ratings and the associated commentary provides a ranking of the configurations used from good to bad. The results are compared to the existing criteria for handling qualities. It is shown that the rankings correlate well with closed-loop performance criterion, and Mil-F-8785 C criteria, whereas other criteria are either not applicable (time history criteria), or inappropriate (static stability criterion, bandwidth criterion). ESA

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N86-26344# Dayton Univ., Ohio.
FLIGHT SIMULATOR: COMPARISON OF RESOLUTION THRESHOLDS FOR TWO LIGHT VALVE VIDEO PROJECTORS Final Report, Oct. 1984 - Aug. 1985
Peter M. Crane, Jost P. Gerlicher, and Herbert H. Bell Jan. 1986 15 p refs
(Contracts F33615-78-C-0026; F33615-84-C-0066)
(AD-A164577; AFHRL-TP-85-43) Avail: NTIS HC A02/MF A01 CSCL 14/2

The Air Force Human Resources Laboratory/Operations Training Division is developing a visual system for advanced tactical air combat simulators. As part of this work, two light valve video projectors were evaluated on their ability to display small, high-contrast images. The angular size of the smallest detail which could reliably be identified by an observer was determined for the General Electric PJ5155 and Sodern SVS-14 Video Projectors for stationary and moving targets under a variety of conditions. Several observers evaluated the projectors using variations of the stairstep procedure to determine minimum resolvable target size. For almost all conditions, observers were able to recognize smaller targets on the General Electric system than on the Sodern. With targets moving horizontally, however, minimum resolvable target size for the General Electric projector was significantly larger than for targets moving vertically or diagonally at the same speed. A hypothesis for this effect is discussed. Author (GRA)

N86-26345# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Geotechnical Lab.
BOMB CRATER REPAIR TECHNIQUES FOR PERMANENT AIRFIELDS. REPORT 3. SERIES 4 TESTS
Samuel J. Alford and George M. Hammitt, II Oct. 1985 66 p
(AD-A164682; WES-TR-GL-81-12-3-Rept-3) Avail: NTIS HC A04/MF A01 CSCL 19/4

This study is a continuation of Reports 1 and 2 of this series which described Series 1, 2, and 3 tests, which were performed using different field methods of repairs and restoration of bomb craters. Results from these tests showed problem areas that needed correction when the crater repairs were trafficked with full-scale loading. Series 4 tests were run to determine: (1) a way to place grout with a minimum of equipment and verify thickness requirements, (2) whether a poor-quality material could be stabilized with high early-strength cement and trafficked early, (3) whether the loose stone problem (Foreign Object Damage (FOD)) encountered with the well-graded crushed limestone could be corrected with a cap of neat grout placed over the limestone, and (4) whether an asphalt with an indefinite storage life could be used for the binder in surface treatments and to obtain additional data with surface treatments as a possible solution for the loose stone problem (FOD) encountered with the crushed limestone. Testing was by accelerated traffic using single- and multiple-wheel gear assemblies. Author (GRA)

N86-26346# Naval Postgraduate School, Monterey, Calif.
ANALYZING THE COST EFFECTIVENESS OF USING FLIGHT SIMULATORS IN THE ISRAELI AIR FORCE M.S. Thesis
Uzzi Rozen Dec. 1985 61 p
(AD-A164864) Avail: NTIS HC A04/MF A01 CSCL 05/9

During the last decade flight simulators have been increasingly used in the training of Israeli pilots. The increasing cost of a training flying hour, the shrinking training airspace over Israel since 1979, and the high performance standards required of the Israeli Air Force air crews were the accelerator factors in this process. This thesis describes a way to analyze the cost effectiveness of the present mix of flight simulators and flying hours in the training process of the I.A.F. air crews. The jet fighters, helicopters, and transportation communities are used as examples to demonstrate the implementation of the analysis. These examples give the reader a general picture of the cost effectiveness of using flight simulators in the I.A.F. Author (GRA)

N86-27150*# National Oceanic and Atmospheric Administration, Boulder, Colo.
SMALL LINEAR WIND TUNNEL SALTATION EXPERIMENTS: SOME EXPERIENCES
D. A. Gillette and P. R. Owen *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p Prepared in cooperation with Imperial College of Science and Technology, London, England (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27154*# Arizona State Univ., Tempe.
DESIGN AND CALIBRATION OF THE CAROUSEL WIND TUNNEL
R. N. Leach, R. Greeley, J. Iversen (Iowa State Univ. of Science and Technology, Ames), B. White (California Univ., Davis.), and J. R. Marshall *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p (For

primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27165*# California Univ., Davis.
AEOLIAN PROCESSES ABOARD A SPACE STATION: SALTATION AND PARTICLE TRAJECTORY ANALYSIS
B. R. White, R. Greeley (Arizona State Univ., Tempe), J. D. Iversen (Iowa State Univ. of Science and Technology, Ames), and R. N. Leach (Santa Clara Univ., Calif.) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N86-26347*# Computer Sciences Corp., Beltsville, Md.
INTERNATIONAL ULTRAVIOLET EXPLORER OBSERVATORY OPERATIONS Final Report, Oct. 1982 - Oct. 1985
Nov. 1985 145 p refs
(Contract NAS5-27295)
(NASA-CR-177873; NAS 1.26:177873; CSC/TR-85/6013) Avail: NTIS HC A07/MF A01 CSCL 22A

This volume contains the final report for the International Ultraviolet Explorer IUE Observatory Operations contract. The fundamental operational objective of the International Ultraviolet Explorer (IUE) program is to translate competitively selected observing programs into IUE observations, to reduce these observations into meaningful scientific data, and then to present these data to the Guest Observer in a form amenable to the pursuit of scientific research. The IUE Observatory is the key to this objective since it is the central control and support facility for all science operations functions within the IUE Project. In carrying out the operation of this facility, a number of complex functions were provided beginning with telescope scheduling and operation, proceeding to data processing, and ending with data distribution and scientific data analysis. In support of these critical-path functions, a number of other significant activities were also provided, including scientific instrument calibration, systems analysis, and software support. Routine activities have been summarized briefly whenever possible. Author

N86-26348*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CALIBRATION OF THE ISEE PLASMA COMPOSITION EXPERIMENT
C. R. Baugher, R. C. Olsen (Alabama Univ., Huntsville), and D. L. Reasoner Mar. 1986 60 p refs Sponsored by NASA. Marshall Space Flight Center, Huntsville, Ala. Prepared in cooperation with Alabama Univ., Huntsville
(NASA-TM-86542; NAS 1.15:86542) Avail: NTIS HC A04/MF A01 CSCL 22A

The Plasma Composition experiment on the ISEE-1 satellite was designed to measure ions from 1 to 16 amu, at energies from near zero to 16 keV. The two nearly identical flight instruments were calibrated by means of preflight laboratory tests and in-flight data comparisons. This document presents most of the details of those efforts, with special emphasis on the low energy (0 to 100 eV) portion of the instrument response. The analysis of the instrument includes a ray-tracing calculation, which follows an ensemble of test particles through the detector. Author

N86-26349# Bundesministerium fuer Wissenschaft und Forschung, Vienna (Austria). Inst. fuer Extraterrestrische Physik.
SPACE RESEARCH AND SPACE TECHNOLOGY. CONTRIBUTIONS BY THE FEDERAL REPUBLIC OF GERMANY
1985 39 p Revised Original contains color illustrations
(ESA-86-96942) Avail: NTIS HC A03/MF A01

West German participation in the Galileo, Giotto, GIRL, and ROSAT missions is described. Spacelab experiments; spaceborne experiments on materials processing; biology and medicine in space; and experimental platforms are discussed. The use of LANDSAT data is summarized. Maritime and communication satellites are treated. ESA

N86-27153*# Iowa State Univ. of Science and Technology, Ames. Dept. of Aerospace Engineering.
SEDIMENT-TRANSPORT EXPERIMENTS IN ZERO-GRAVITY
James D. Iversen and Ronald Greeley (Arizona State Univ., Tempe) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27156*# Arizona State Univ., Tempe. Dept. of Geology.
ELECTROSTATIC AGGREGATION OF FINELY-COMMINUTED GEOLOGICAL MATERIALS
J. R. Marshall and R. Greeley *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27158*# National Aeronautics and Space Administration, Washington, D.C.
NUCLEATION EXPERIMENTS IN A MICROGRAVITY ENVIRONMENT
J. A. Nuth, J. E. Allen, Jr. (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.), L. U. Lilleleht (Virginia Univ., Charlottesville), I. D. R. Mackinnon (Microbeam, Inc., Houston, Tex.), F. J. M. Rietmeijer (National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.), and J. R. J. M. Stephens (Los Alamos National Lab., N. Mex.) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27162*# Brown Univ., Providence, R. I. Dept. of Geological Sciences.
IMPACTS OF FREE-FLOATING OBJECTS: UNIQUE SPACE STATION EXPERIMENTS
P. H. Schultz and D. E. Gault (Murphys Center of Planetology, Calif.) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27164*# California Inst. of Tech., Pasadena. Div. of Physics, Mathematics and Astronomy.
GRAIN DYNAMICS IN ZERO GRAVITY
B. T. Werner and P. K. Haff *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27166*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
A SYSTEM FOR CONDUCTING IGNEOUS PETROLOGY EXPERIMENTS UNDER CONTROLLED REDOX CONDITIONS IN REDUCED GRAVITY
R. J. Williams *In its* Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

No abstracts in this category.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air).*

N86-27141*# California Inst. of Tech., Pasadena. Seismological Lab.
A PLANETARY ULTRA HYPERVELOCITY IMPACT MECHANICS AND SHOCK WAVE SCIENCE FACILITY
Thomas J. Ahrens *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 5 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27155*# Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.
A MAGNETOSPHERIC SIMULATION AT THE SPACE STATION
R. E. Lopez, J. W. Freeman, and F. C. Michel *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 1 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27160*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
LOW GRAVITY FACILITIES FOR SPACE STATION PLANETOLOGY EXPERIMENTS
Paul A. Penzo *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N86-26350# Lawrence Livermore National Lab., Calif.
BALLISTIC FLIGHT OF A PROJECTILE WITH TWO PRECESSIONAL MODES
T. Morgan 21 Nov. 1985 16 p Presented at the 24th AIAA Aerospace Science Meeting, Reno, Nev., 6-9 Jan. 1986 Original language document was announced in AIAA as A86-19923 Submitted for publication
(Contract W-7405-eng-48)
(DE86-003176; UCRL-93639; CONF-860130-3) Avail: NTIS HC A02/MF A01

Rapidly spinning projectiles with infinite rotational symmetry display a high degree of physical correspondence to a classical gyroscope. As with a gyroscope, such projectiles show two precessional modes, one of which will always be in evidence during a flight. Aeroballistic theory provides, additionally, for two simultaneously excited nutational modes, with sinusoidal frequencies close to, but not exactly coincident with, the precessional angular velocities. The combination of these two orthonormal rotations gives rise to complex pitching and yawing motion, which can be substantially different than the motion predicted by aeroballistic theory alone. Results from a numerical integration of the equations of motion in their most general form illustrate these differences.
DOE

N86-26351# Morton Thiokol, Brigham City, Utah.
MINUTEMAN 3, STAGE 3 SURVEILLANCE Semiannual Report, 1 Jun. - 30 Nov. 1985
Ralph Davis and L. C. Porter, Jr. Jan. 1986 42 p
(Contract F42600-86-C-0001)
(AD-A164840; TWR-32233) Avail: NTIS HC A03/MF A01 CSCL 21/8

The program effort during this reporting period consisted of laboratory testing of both the Morton Thiokol, Inc./ASPC Minuteman 3 Third Stage Surveillance components and material samples. In addition, bondline aging testing and analysis using samples from previously dissected motors were accomplished. In support of the program, all flight and static tests, for both First and Third Stage Minuteman motors, were reviewed and tabulated for incorporation into reliability and motor historical records.
GRA

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation.*

N86-26352* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MAGNETIC SPIN REDUCTION SYSTEM FOR FREE SPINNING OBJECTS Patent
Georg F. vonTiesenhausen, inventor (to NASA) Issued 15 Apr. 1986 6 p Supersedes N85-11122 Filed 23 Aug. 1984 Sponsored by NASA
(NASA-CASE-MFS-25966-1; US-Patent-4,582,277; US-Patent-Appl-SN-643522; US-Patent-Class-244-161) Avail: US Patent and Trademark Office CSCL 22B

A spinning Earth satellite is shown in which it is desired to reduce the rotation or spin to a level that the satellite may be secured or handled remotely from a spacecraft. This is accomplished by the spacecraft having a mast carrying an electrical current coil which encircles the satellite. The magnetic field of the coil is normal to the spin axis of the satellite which causes circular eddy current flow in the housing of the satellite. This generates magnetic force opposing the rotation. In another embodiment the magnetic field is generated by the use of an electromagnet on a remote manipulation arm.
Official Gazette of the U. S. Patent and Trademark Office

N86-26353# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
DEFINITION STUDY OF A COORDINATED GROUP OF EXPERIMENTS TO MEASURE AND MONITOR THE IN SITU PLASMA AND ELECTROMAGNETIC ENVIRONMENT OF A POLAR ORBITING SPACE SHUTTLE Final Report, 18 Feb. 1983 - 18 Feb. 1985
Herbert S. Bridge and Joseph H. Binsack Sep. 1985 105 p refs
(Contract F19628-83-K-0030)
(AD-A164561; AFGL-TR-85-0238) Avail: NTIS HC A06/MF A01 CSCL 22/1

The contents of this report include: The Environment Monitoring Payload; Radiation of Plasma Waves by a Conducting Body Moving Through a Magnetized Plasma; and Phase and Group Velocities of Waves in Cold Plasma.
GRA

N86-26354*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INTERACTIONS MEASUREMENT PAYLOAD FOR SHUTTLE (IMPS) DEFINITION PHASE STUDY Final Report, 23 May

1983 - 15 Dec. 1984
Gary C. Hill 15 Dec. 1984 198 p
(Contracts NAS7-918; DA Proj. 2822)
(NASA-CR-177291; NAS 1.26:177291; JPL-D-1865; AD-A165222; AFGL-TR-85-0023) Avail: NTIS HC A09/MF A01 CSCL 22B

The Interactions Measurement Payload for Shuttle (IMPS) project will study interactions between large space vehicles, such as the space shuttle, and the low altitude plasma environment over the polar caps and in the auroral zone. Studies will be conducted from the orbiter bay and from a shuttle-based subsatellite; several investigations; and an environmental monitoring package. This will be the first of a series of missions to begin in 1978. This definition phase report presents the objectives and requirements of the IMPS project and instrument system followed by the mission design they dictate. The bulk of the report is a technical discussion of the investigations and work done on the space and instrument systems, describing both their capabilities and limitations. A description of the steps for reliability/quality assurance is followed by the recommendations of the JPL engineers and scientist involved in this phase of the IMPS project. GRA

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications.*

No abstracts in this category.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics.*

N86-26355*# National Aeronautics and Space Administration, Washington, D.C.
ENVIROSAT-2000 REPORT: FEDERAL AGENCY SATELLITE REQUIREMENTS
D. Cotter, ed., I. Wolzer, ed., N. Blake, J. Jarman, D. Lichy, T. Pangburn, R. McArdle, C. Paul, L. Shaffer, G. Thorley et al NOAA Jul. 1985 156 p refs
(NASA-TM-88752; NAS 1.15:88752) Avail: NTIS HC A08/MF A01 CSCL 22B

The requirement of Federal agencies, other than NOAA, for the data and services of civil operational environmental satellites (both polar orbiting and geostationary) are summarized. Agency plans for taking advantage of proposed future Earth sensing space systems, domestic and foreign, are cited also. Current data uses and future requirements are addressed as identified by each agency. B.G.

N86-26356# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
MODELLING OF A COLD GAS JET SYSTEM FOR SATELLITE ATTITUDE CONTROL
Ismael EmiliodeOliveiraFilho and Eduardo Augusto Gomes Pereira Apr. 1986 6 p refs Presented at TELECON'85, Rio de Janeiro, Brazil, 10-13 Dec. 1985
(INPE-3853-PRE/917) Avail: NTIS HC A02/MF A01

For the Earth orbiting satellite to accomplish its objectives, it is of main concern that it keep a certain attitude in relation to the planet. Among the existing attitude control actuators, the gas jet is the one with the widest application because of its large range of torque generation capability and because of its independence in relation to other kinds of systems. To be able to use a gas jet system, however, it is fundamental to know its time performance. This work proposes a mathematical modelling for the thrust of a basic gas jet system, including on-off transient times. The model considers two valves in the line: a pressure regulating one and a control one. The latter is modelled in detail and its on and off times are obtained analytically. Expressions for the thrust and mass flow with time are also obtained. Transient times and thrust are calculated numerically and considered coherents with prevision. Author

N86-26357*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DYNAMIC CHARACTERISTICS OF POWER-TOWER SPACE STATIONS WITH 15-FOOT TRUSS BAYS
John T. Dorsey Jul. 1986 72 p
(NASA-TM-87684; L-16094; NAS 1.15:87684) Avail: NTIS HC A04/MF A01 CSCL 22B

A power tower space station concept which generates power with photovoltaic arrays and where the truss structure has a bay size of 15 ft is described. Rigid body and flexible body dynamic characteristics are presented for a 75-kW Initial Operating Capability (IOC) and 150-kW and 300-kW growth stations. The transient response of the IOC and 300-kW growth stations to shuttle dock, orbit reboost, and mobile remote manipulator system translation loads are studied. Displacements, accelerations, and bending moments at various locations on the IOC and 300-kW growth stations are presented. Author

N86-26358*# Evansville Univ., Ind. Dept. of Physics.
THEORETICAL STUDY ON THE EFFECT OF THE DESIGN OF SMALL (MILLI-NEWTON) THRUSTER JETS ON MOLECULAR CONTAMINATION FOR THE SPACE STATION Final Report, 15 Nov. 1985 - 30 Jun. 1986
Ben R. Riley 1986 44 p refs
(Grant NAG3-674)
(NASA-CR-177263; NAS 1.26:177263) Avail: NTIS HC A03/MF A01 CSCL 22B

The self-induced molecular contamination around the space station could have adverse effects on space station components (for example solar panels) as well as scientific experiments that might be done on or near the space station. Aerospace engineers need to design a space station (SS) propulsion system that keeps the SS in a stable orbit and at the same time does not allow the propellant gases to interfere with the experiments of the user. One scenario that might accomplish the above requirements is to use an electrothermal propulsion system, resistojet, that will thrust continuously in the hundreds of milli-Newton range which will provide a constant altitude for the SS with a low g environment. As a first attempt to understand the contamination from such a propulsion system, a point source model was developed. The numerical results of the point source model are given. Number column densities for CO2 are presented as a function of direction of observation (line of sight), temperature of the exit gas, and mean exit velocity. All the results are for a constant exhaust rate of 5,000 kg/year. In addition, a mathematical model to study the effect of nozzle design on the induced molecular environment around the space station produced by simple gas propellants is described. The mathematical model would allow one to follow the expansion of the gas from the throat of a nozzle to the nozzle exit plane and then into the space external to the nozzle. M.G.

N86-26359# SoHaR, Inc., Los Angeles, Calif.
RELIABILITY PREDICTION FOR SPACECRAFT Final Report, Mar. 1983 - Jan. 1985
Herbert Hecht and Myron Hecht Dec. 1985 152 p
(Contract F30602-83-C-0018)
(AD-A164747; RADC-TR-85-229) Avail: NTIS HC A08/MF A01

CSCL 22/2

This study provides the basis for improving the utility of Mil-Hdbk-217 for reliability prediction of spacecraft components and systems. The reliability performance histories of 300 satellite vehicles, which were launched between the early 1960's through Jan. '84, were reviewed and analyzed during the course of the study. Analysis of over 2500 reports of malfunctions indicated strong evidence of a decreasing failure rate with time in orbit. The cause for the decreasing hazard was found to be traceable primarily to design and environmental causes. In general, however, it was found that current predictions overestimate the failure rate by at least a factor of two and that the excess of predicted over observed failures increases with time in orbit. Three methods are provided for spacecraft reliability prediction. In order to account for the decreasing hazard, two of the procedures use a Weibull model with parameters based upon similar spacecraft mission types. A third method uses modifications of Mil-Hdbk-217 procedures to account for the overestimation of failure rates which result when current procedures are used. GRA

N86-26360# Aerospace Corp., El Segundo, Calif. Information Processing Div.

ANALYSIS OF ORBITAL SATELLITE STORAGE

T. L. Ferguson and T. H. Davey Nov. 1985 70 p refs

(Contract F04701-85-C-0086)

(AD-A164971; TR-0086(6417-03)-1; SD-TR-86-02) Avail: NTIS HC A04/MF A01 CSCL 22/2

This study addresses whether service of sufficient duration can be expected from a satellite that has been stored on orbit for significant periods of time. The question was approached in two ways. First, an extensive review of the research on orbital storage was conducted. While there has not been a great deal of published analysis of the subject, the records of those efforts are consistent in their conclusions that orbital storage does not appear to have any adverse impact on satellites or their redundant components. The second approach was empirical. A data set was collected, consisting of the dormant and post-dormant characteristics of redundant electronic boxes from 155 NASA, DOD and commercial satellites. Three separate investigations examined length of dormancy and subsequent length of activity of redundant units to statistically determine any relationship. GRA

N86-26361# National Aerospace Lab., Amsterdam (Netherlands). Space Div.

STUDY OF NAVSAT CONTROL SEGMENT CHARACTERISTICS. PART 1: ELEMENTS OF A CONTROL SEGMENT CONCEPT Final Report

L. J. M. Joosten, P. J. dePagter, O. B. M. Pietersen, J. J. Renes, and H. F. A. Roefs Paris, France ESA 18 Sep. 1984 129 p Prepared in cooperation with Technische Hogeschool, Delft 3 Vol.

(Contract ESA-5501/83-F-RD(SC))

(NLR-TR-84086-L-Pt-1; ESA-CR(P)-2145-Vol-1; ESA-86-96871) Avail: NTIS HC A06/MF A01

The division of tasks between Navsat Regional and Mission Center is established and intercenter communication requirements and options are discussed. Equipment for the uplink and downlink stations, particularly the antenna systems, is studied. Time synchronization between the broadcasting moments of satellite navigation signals emitted by the different satellites is addressed. The forward time correction of the uplink signals and the measurement of the interstation time differences are investigated. Measurement of ionospheric delay is addressed by introducing the dual-frequency navigation method. The impact of the dual-frequency method in the space segments, especially the Doppler properties of the navigation signal in terms of frequency stability and control, is assessed. The use of the S-band for communication is treated. ESA

N86-26362# National Aerospace Lab., Amsterdam (Netherlands). Space Div.

STUDY OF NAVSAT CONTROL SEGMENT CHARACTERISTICS. PART 2: ORBIT COMPUTATION ASPECTS Final Report

K. F. Wakker, B. A. C. Ambrosius, H. Leenman, R. Noomen, H. J. D. Piersma, T. vanderPloeg, and E. J. O. Schrama Paris, France ESA 18 Sep. 1984 169 p Prepared in cooperation with Technische Hogeschool, Delft 3 Vol.

(Contract ESA-5501/83-F-RD(SC))

(NLR-TR-84086-L-Pt-2; ESA-CR(P)-2145-Vol-2; ESA-86-96872) Avail: NTIS HC A08/MF A01

Orbit computation requirements for the 24 satellites in the Navstar global navigation network are discussed. Satellite orbits and the visibility of the satellites from the uplink stations are considered. The range tracking concept is introduced. The feasibility of compressing the ranging data is investigated. The maximum orbit prediction interval which satisfies orbit accuracy requirements is shown. The fitting of the predicted orbit by a set of polynomials is outlined. An orbit improvement scheme is presented. ESA

N86-26363# National Aerospace Lab., Amsterdam (Netherlands). Space Div.

STUDY OF NAVSAT CONTROL SEGMENT CHARACTERISTICS. PART 3: EXECUTIVE SUMMARY Final Report

L. J. M. Joosten and K. F. Wakker (Technische Hogeschool, Delft, Netherlands) Paris, France ESA 19 Apr. 1985 33 p 3 Vol.

(Contract ESA-5501/83-F-RD(SC))

(NLR-TR-84086-L-Pt-3; ESA-CR(P)-2145-Vol-3; ESA-86-96873) Avail: NTIS HC A03/MF A01

The Navsat global navigation satellite network mission and regional centers are described. Satellite orbit determination and prediction are outlined. ESA

N86-26364# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

FURTHER WORK ON POPSAT. VOLUME 1: EXECUTIVE SUMMARY Final Report

B. Schuerenburg, L. Popken, G. Thieme, and C. Clarisse (Electronique Serge Dassault, St. Cloud, France) Paris, France ESA Aug. 1985 30 p 2 Vol.

(Contract ESA-5960/84-NL-MD)

(ESA-CR(P)-2148-Vol-1; ESA-86-96874) Avail: NTIS HC A03/MF A01

Data modulation methods for the POPSAT microwave tracking system; the POPSAT time synchronization experiment; correction for nongravitational disturbances; and the POPSAT attitude and orbit control concept are discussed. For data modulation, BPSK is recommended. The time synchronization experiment requires a larger field of view than LASSO. Surface force modeling is best for correcting nongravitational disturbances. Gravity gradient stabilization enhanced by magnetic torquers is suggested for the satellite control. ESA

N86-26365# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). Space Div.

FURTHER WORK ON POPSAT. VOLUME 2: TECHNICAL RESULTS Final Report

B. Schuerenburg, L. Popken, G. Thieme, D.C. Ulrich, and C. Clarisse (Electronique Serge Dassault, St. Cloud, France) Paris ESA Aug. 1985 358 p

(Contract ESA-5960/84-NL-MD)

(ESA-CR(P)-2148-Vol-2; ESA-86-96875) Avail: NTIS HC A16/MF A01

Data modulation methods for the POPSAT microwave tracking system; the POPSAT time synchronization experiment; correction for nongravitational disturbances; and the POPSAT attitude and orbit control concept are discussed. For data modulation, BPSK is recommended. The time synchronization experiment requires a larger field of view than LASSO. Surface force modeling is best for correcting nongravitational disturbances. Gravity gradient stabilization enhanced by magnetic torquers is suggested for the satellite control. ESA

N86-26366# National Aerospace Lab., Amsterdam (Netherlands). Space Div.

ATTITUDE ESTIMATION AND CONTROL OF MANEUVERING SPACECRAFT

T. Zwartbol, R. F. vandenDam, A. P. Terpstra, and P. Th. L. M. vanWoerkom 22 May 1984 19 p Revised Submitted for publication
(NLR-MP-84036-U; B8578436; ESA-86-96968) Avail: NTIS HC A02/MF A01

Application of sampled data, on board model-following, control, and estimation techniques to attitude control of high performance, maneuvering spacecraft is described. Model-following control comprises three simultaneous modes: target generation and control, disturbance accommodation control, and regulator control. The actuator is a reaction wheel. Estimation is carried out by two separate Kalman filters. One filter processes measurements from a rate-integrating gyro; output is an estimate of a three-dimensional spacecraft state vector. A second filter processes a-periodic measurements from a strapdown star sensor; output is an estimate of a three-dimensional gyro-parameter state vector. Estimation and control algorithms tests in closed-loop software simulations show very satisfactory performance. The algorithms were implemented in a 16 bit digital computer on board IRAS. In-flight estimation and control experiments produce very good results. ESA

N86-26367# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
MATHEMATICAL MODELS OF FLEXIBLE SPACECRAFT DYNAMICS: A SURVEY OF ORDER REDUCTION APPROACHES Annual Report, 1984
P. Th. L. M. vanWoerkom 21 Jan. 1985 13 p Presented at 10th IFAC Symp. on Automatic Control in Space, Toulouse, France, 25-29 Jun. 1985
(Contracts NIVR-1910)
(NLR-MP-85004-U; B8578426; ESA-86-96974) Avail: NTIS HC A02/MF A01

The usefulness of open loop model order reduction techniques for application of flexible spacecraft dynamics models was assessed. Approaches identified involve parameter optimization; aggregation; singular perturbation; modal dominance; component cost analysis; and internal balancing. The latter three approaches appear to be most meaningful, and convenient in applications. The problem of model order reduction is reviewed, and each of the six approaches is discussed. The latter three approaches are applied to the case of a long, flexible beam in space, controlled with two line torquers. ESA

N86-27147*# National Aeronautics and Space Administration, Washington, D.C.
SPACE STATION SCIENCE LAB MODULE
D. L. DeVincenzi *In* NASA. Lyndon B. Johnson Space Center Space Statiaon Planetology Experiments (SSPEX) May 1986 5 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N86-26368* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PROPULSION APPARATUS AND METHOD USING BOIL-OFF GAS FROM A CRYOGENIC LIQUID Patent
Dale H. Blount, inventor (to NASA) Issued 29 Apr. 1986 7 p Supersedes N84-15183 Filed 29 Apr. 1986 Sponsored by NASA
(NASA-CASE-MFS-25946-1; US-Patent-4,585,191;
US-Patent-Appl-SN-561432; US-Patent-Class-244-169;
US-Patent-Class-244-158.R; US-Patent-Class-60-203.1;
US-Patent-Class-60-39.465) Avail: US Patent and Trademark Office CSCL 21H

A propulsion system and method are disclosed for controlling the attitude and drag of a space vehicle. A helium dewar contains liquid helium which cools an experiment package. The helium is heated or vented to keep the temperature between 1.5 and 1.7 degrees K to maintain adequate helium boil-off gas as a propellant without adversely affecting the experiment package which is contained in the helium dewar for protection from solar heating. The apparatus includes auxiliary heater and temperature sensor for controlling the temperature of the helium. The boil-off gas propellant is delivered to thruster modules to control vehicle attutude and compensate for drag.
Official Gazette of the U. S. Patent and Trademark Office

N86-26369*# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
ORBIT TRANSFER ROCKET ENGINE TECHNOLOGY PROGRAM: ADVANCED ENGINE STUDY, TASK D.1/D.3 Interim Report
A. Martinez, C. Erickson, and B. Hines Jan. 1986 237 p
(Contract NAS3-23773)
(NASA-CR-175084; NAS 1.26:175084; RI/RD86-116) Avail: NTIS HC A11/MF A01 CSCL 21H

Concepts for space maintainability of OTV engines were examined. An engine design was developed which was driven by space maintenance requirements and by a failure mode and effects (FME) analysis. Modularity within the engine was shown to offer cost benefits and improved space maintenance capabilities. Space operable disconnects were conceptualized for both engine change-out and for module replacement. Through FME mitigation the modules were conceptualized to contain the least reliable and most often replaced engine components. A preliminary space maintenance plan was developed around a controls and condition monitoring system using advanced sensors, controls, and condition monitoring concepts. A complete engine layout was prepared satisfying current vehicle requirements and utilizing projected component advanced technologies. A technology plan for developing the required technology was assembled. Author

N86-26370# Ballistic Research Labs., Aberdeen Proving Ground, Md.
THE MUZZLE FLASH OF GUNS AND ROCKETS: A TRANSLATION Final Report
Joseph M. Heimeri Dec. 1985 28 p refs Transl. into ENGLISH of "Das Muendungesfeuer bei Geschuetzen und Raketen" Rept. 11/48 19 Jul. 1948
(AD-A164593; BRL-SP-50; Rept-11/48) Avail: NTIS HC A03/MF A01 CSCL 19/6

This is a translation of a report that summarized the experimental work done in Germany up to about the year 1945 in the field of muzzle flash suppression. The experiments used real gun systems and employed a large number of different chemical additives as potential suppressants. Negative, as well as positive, results were reported. A brief discussion on rocket afterburning suppression and smoke attenuation was also given. Author (GRA)

N86-26371# Weather Squadron (2nd), Patrick AFB, Fla. Detachment 11.
OPERATIONAL USE OF THE REEDM (ROCKET EXHAUST EFFLUENT DIFFUSION MODEL) Final Report
Billie F. Boyd 3 Jul. 1985 20 p refs
(AD-A164965; Rept-2WS/CP-85/005) Avail: NTIS

HC A02/MF A01 CSCL 20/4

This document presents operational considerations in the use of the NASA (Marshall Space Flight Center) Rocket Exhaust Effluent Diffusion code and the resultant Rocket Exhaust Effluent Diffusion Model (REEDM). It concentrates on that area outside the REEDM Code: The meteorological data that goes into the code and its significance. GRA

N86-26372# Army Materiel Test and Evaluation Directorate, White Sands Missile Range, N. Mex.

SAFETY TESTING OF MISSILE AND ROCKET SYSTEMS EMPLOYING MANNED LAUNCH STATIONS Final Report

15 Jan. 1986 76 p Supersedes TOP-5-2-619 and AD-B077876 (AD-A165395; ITOP-5-2-619; AMSTE-RP-702-104) Avail: NTIS HC A05/MF A01 CSCL 13/12

This ITOP (International Test Operating Procedure) describes the procedures for safety testing of systems listed in the title during development and production testing. It includes tests of motors, warheads, and other components which would affect stockpile-to-launch safety, as well as complete system firing tests. It specifies tests which are conducted to provide the safety release and other safety evaluation data. GRA

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N86-26373*# Salk Institute for Biological Studies, San Diego, Calif.

STEREOSELECTIVE FORMATION OF A 2 PRIME (3 PRIME)-AMINOACYL ESTER OF A NUCLEOTIDE

Arthur L. Weber 1986 17 p refs

(Grant NsG-7627)

(NASA-CR-176830; NAS 1.26:176830) Avail: NTIS HC A02/MF A01 CSCL 07A

Reaction of DL-series and adenosine-5-phosphorimidazolide in the presence of adenosine-5'-(0-methylphosphate) and imidazole resulted in the stereoselective synthesis of the aminoacyl nucleotide ester, 2'(3')-0-seryl-adenosine-5'-(0-methylphosphate). The enantiomeric excess of D-serine incorporated into 2'(3')-0-seryl-adenosine-5'-(0-methylphosphate) was about 9%. Adenylyl-(5->' N)-serine and an unknown product also incorporated an excess of D-serine, however, seryl-serine showed an excess of L-serine. The relationship of these results to the origin of the biological pairing of L-amino acids and nucleotides containing D-ribose is discussed. Author

24 COMPOSITE MATERIALS

Includes laminates.

N86-26374*# National Aeronautics and Space Administration, Washington, D.C.

ON THE SINTERING OF SILICON CARBIDE

E. Gugel Mar. 1986 13 p refs Transl. by the Corporate Word, Inc., Pittsburgh, Pa.

(Contract NASw-4006)

(NASA-TM-88402; NAS 1.15:88402) Avail: NTIS HC A02/MF A01 CSCL 11D

This document deals with the sintering of silicon carbide using pressureless sintering. This technique makes it possible to sinter a primarily covalent material to usable densities up to over 98% thD without having to use a high amount of sinter additives as is the case with other non-oxide ceramic materials. The process takes place rapidly, and it is also possible to produce relatively thick-walled structural parts without major problems. This sheds more light on the true characteristics of silicon carbide in one structural part, since there is no second or nearly no second phase. Heat pressing has improved stability. Author

N86-26375# Los Alamos National Lab., N. Mex.

SILICON CARBIDE WHISKERS FOR COMPOSITES: GROWTH AND PROPERTIES

G. F. Hurley and J. J. Petrovic 1985 8 p Presented at the ASM/ESD Advanced Composites Conference, Dearborn, Mich., 3-4 Dec. 1985

(Contract W-7405-eng-36)

(DE86-000798; LA-UR-85-3453; CONF-851244-1) Avail: NTIS HC A02/MF A01

Silicon carbide (SiC) whiskers have great potential as reinforcements for structural ceramic matrix composites with significantly improved fracture toughness and strength. Such whiskers, synthesized at Los Alamos by a vapor-liquid-solid (VLS) process, are single crystal fibers with diameters in the range of 0.1 to 10 (MU)m and lengths presently as long as 100 mm. They possess superb mechanical properties, with an average strength of 8.4 GPa (1,220,000 psi) and an average elastic module of 580 GPa (84,000,000 psi), as well as excellent elevated temperature stability. Future possibilities include the synthesis of long SiC whiskers for continuous fiber composites, and other types of whisker materials to extend the range of new ceramic composite systems. DOE

N86-26376*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPUTATIONAL SIMULATION OF PROGRESSIVE FRACTURE IN FIBER COMPOSITES

Christos C. Chamis 1986 12 p refs Presented at the International Conference on Computational Mechanics, Tokyo, Japan, 25-28 May 1986

(NASA-TM-87341; E-3090; NAS 1.15:87341) Avail: NTIS HC A02/MF A01 CSCL 11D

Computational methods for simulating and predicting progressive fracture in fiber composite structures are presented. These methods are integrated into a computer code of modular form. The modules include composite mechanics, finite element analysis, and fracture criteria. The code is used to computationally simulate progressive fracture in composite laminates with and without defects. The simulation tracks the fracture progression in terms of modes initiating fracture, damage growth, and imminent global (catastrophic) laminate fracture. Author

N86-26377*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.

MEASURE OF DISPLACEMENT AROUND HOLES IN COMPOSITE PLATES SUBJECTED TO QUASI-STATIC COMPRESSION

John C. Duke, Jr., Daniel Post, Robert Czarnek, and Anand Asundi Washington Jun. 1986 65 p refs

(Grant NAG1-193)

(NASA-CR-3989; NAS 1.26:3989) Avail: NTIS HC A04/MF A01 CSCL 11D

Contour maps of thickness changes were obtained for three quasi-isotropic graphite-epoxy plates with central holes, loaded in compression. Thickness changes were determined for six load increments from nearly zero to within a few percent of the failure load. The largest change of thickness occurred near the hole but not at the boundary of the hole. Below 90 percent of the failure load, the thickness changes were nearly proportional to load. Irregularities of thickness changes occurred in zones of compressive stresses and they were attributed to localized fiber buckling. A new optical technique was developed to measure thickness changes with high sensitivity. It utilizes a comparatively simple means of holographic interferometry on both sides of the specimen, followed by additive moire to obtain thickness changes as the sum of the out-of-plane displacements. Sensitivity was 12.5 x 10 to the -6 power in. per fringe order. The fringe patterns represent thickness changes uniquely, even when specimen warpage and consequent out-of-plane displacements are very large. Author

N86-26378# Aeronautical Research Labs., Melbourne (Australia).
ENVIRONMENTAL EFFECTS ON THE STATIC AND FATIGUE STRENGTH OF GRAPHITE/EPOXY STRUCTURES
R. J. Callinan Sep. 1985 34 p
(AR-004-044; ARL-STRUC-R-417) Avail: NTIS HC A03/MF A01

It is well known that moisture and temperature can degrade the properties of graphite-epoxy structures. Those laminates, loading conditions, and environments which may result in substantial reductions in static strength and fatigue life are identified.
Author

N86-26379*# George Washington Univ., Washington, D.C. School of Engineering and Applied Science.
THE EFFECT OF LOW VELOCITY IMPACT ON THE STRENGTH CHARACTERISTICS OF COMPOSITE MATERIALS LAMINATES Progress Report
H. Liebowitz 7 Jan. 1986 86 p refs
(Grant NAG1-158)
(NASA-CR-176846; NAS 1.26:176846) Avail: NTIS HC A05/MF A01 CSCL 11D

The nonlinear and dynamic response of composite structures to impact loading conditions was investigated. The convergence of both finite element and finite difference solution procedures was investigated with this configuration. The response of composite beams and plates to impact were examined. Fundamental data on the indentation and flexural response of both plate and beam geometry were collected. Numerical analyses were extended to the study of circular plates subjected to impact loading. Further work was done in modeling the response to simulated impact loading through careful modeling of the momentum transfer from impactor to target. The modeling methodology and solution procedures were well tested and verified. A computer program for the solution of circular plate problems was developed and is under testing. B.G.

N86-26380*# Missouri Univ., Rolla. Dept. of Engineering Mechanics.
CRITERION FOR MIXED MODE FRACTURE IN COMPOSITE BONDED JOINTS Final Report
S. Mall and N. K. Kochhar May 1986 27 p
(Grant NAG1-425)
(NASA-CR-178112; NAS 1.26:178112) Avail: NTIS HC A03/MF A01 CSCL 11D

A study was undertaken to characterize the debond growth mechanism of adhesively bonded composite joints under mode I, mixed mode I-II, and mode II static loadings. The bonded system consisted of graphite-epoxy composite adherends bonded with a toughened epoxy adhesive. The mode I, mode II and mixed mode I-II fracture energies of the tested adhesives were found to be equal to each other. The criterion for mixed mode fracture in composite bonded joints was found. Author

N86-26381# Office of Naval Research, London (England).
THE DAMAGE TOLERANCE OF CARBON FIBER REINFORCED COMPOSITES: A WORKSHOP SUMMARY
Kenneth D. Challenger 15 Jan. 1986 20 p Workshop held in Glasgow, Scotland, 12 Sep. 1985
(AD-A163757; ONRL-C-15-85) Avail: NTIS HC A02/MF A01 CSCL 11/4

The workshop held in Glasgow, Scotland on 12 September 1985 included participants from the US, the UK, Australia, West Germany, and France. Six critical problem areas associated with damage tolerance of carbon-fiber reinforced composite materials are discussed: damage tolerant materials, testing methods, structural life prediction, damage tolerant design concepts, repair methods, and nondestructive testing. Author (GRA)

N86-26382# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
ACCELERATED CORROSION TESTING OF GRAPHITE/EPOXY COMPOSITES AND ALUMINUM ALLOY MECHANICALLY-FASTENED JOINTS Final Report, 1 May 1980 - 20 Dec. 1984
S. D. Thompson, Billy L. White, and James A. Snide 20 Jun. 1985 50 p
(AD-A164772; AFWAL-TR-84-3115) Avail: NTIS HC A03/MF A01 CSCL 11/4

This program evaluates the effectiveness of a currently used finishing system to protect graphite/epoxy composites mechanically fastened to aluminum substructures with either titanium or A-286 CRES fasteners. Lap joint samples of laminated graphite/epoxy (+ or - 45/O2/9O)4/+ or - 45/O)s and aluminum alloy plates (2124-T851) were fabricated using either titanium (NAS1154V4) or A-286 CRES (MS 21140) fasteners. The unprotected baseline samples were fabricated by installing the fasteners in the uncoated graphite/epoxy aluminum alloy plates. The protected samples were exposed to humidity and salt fog for twelve weeks, tested in fatigue and exposed to the corrosive environment for twelve more weeks. The extent of corrosion was evaluated by both visual and microscopic examination. The unprotected samples experienced severe galvanic corrosion of the aluminum plate. The accelerated testing of the protected samples indicated the following problems: (1) If the area where the composite butts together in the lap joint was not properly sealed galvanic corrosion could occur in the aluminum. (2) If the composite was not painted on the edge, severe pitting of the primed aluminum alloy plate would occur on the edge of the aluminum plate. (3) The titanium fasteners performed better than the A-286 CR ES fasteners. GRA

N86-26383# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Civil Engineering.
THERMAL EXPANSION OF ELASTIC-PLASTIC COMPOSITE MATERIALS
George J. Dvorak Oct. 1985 38 p refs
(Contract N00014-85-K-0247)
(AD-A164910; CECM-1) Avail: NTIS HC A03/MF A01 CSCL 11/4

Exact relationships are derived between instantaneous overall thermal stress or strain vectors and instantaneous overall mechanical stifness or compliance, for two binary composite systems in which one of the phases may deform plastically. Also the local instantaneous thermal strain and stress concentration factors are related in an exact way to the corresponding mechanical concentration factors. The results depend on instantaneous thermoelastic constants and volume fractions of the phases. They are found for fibrous composites with two distinct elastically isotropic or transversely isotropic phases, and for any binary composite with elastically isotropic phases. The results indicate that in the plastic range the thermal and mechanical loading effects are coupled even if the phase properties do not depend on changes in temperature. The derivation is based on a novel decomposition procedure which indicates that spatially uniform elastic strain fields can be created in certain heterogeneous media by superposition of uniform phase eigen-strains with local strains caused by piecewise uniform stress fields which are in equilibrium with prescribed surface tractions. The method is extended to discretized microstructures, and also to analysis of moisture absorption and phase transformation effects on overall response and on local fields in the two composite materials. Author (GRA)

N86-26384# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
EVALUATION OF THE EFFECTS OF A PLASTIC BEAD PAINT REMOVAL PROCESS ON PROPERTIES OF AIRCRAFT STRUCTURAL MATERIALS Final Report, Oct. 1984 - Aug. 1985
Sidney Childers, David C. Watson, Patricia Stumpff, and Jon Tirpak Dec. 1985 151 p
(AD-A165289; AD-F630715; AFWAL-TR-85-4138) Avail: NTIS HC A08/MF A01 CSCL 11/4

An abrasive blasting process using plastic beads has been proposed for removing organic coatings from aircraft surfaces and component parts. During the prototype development of the plastic bead blasting process for paint removal many concerns surfaced relative to the potential effects of the process on metal and composite aircraft structural materials. This evaluation of the plastic bead blasting paint removal showed that it removed

protective metal coatings such as aluminum cladding and anodize coatings from aluminum alloys and cadmium plating from steel structure. Surface roughness resulted on clad aluminum alloys. Warpage as a result of surface cold working occurred on unsupported thin skin metal materials. The bond strength of thin skin adhesive bonded structure was not affected. The process is less damaging in fatigue to 7075-T6 aluminum structure blasted at 60 psi nozzle pressure than at 38 psi nozzle pressure. Epoxy/graphite composite structure which was plastic bead blasted showed statistically significant losses in the matrix dominated properties. No significant reductions occurred in the fiber dominated mechanical properties. GRA

N86-26385# BDM Corp., Huntsville, Ala.
ADVANCED MATERIALS RESEARCH STATUS AND REQUIREMENTS. VOLUME 1: TECHNICAL SUMMARY Final Report
Jonathan A. Lee and Donald L. Mykkanen Mar. 1986 40 p
(Contract DASG60-85-C-0087)
(AD-A165338; BDM/H-86-0115-TR-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 11/6

This document describes the status and requirements of advanced composite materials which are being considered for engineering structural applications to U.S. Army Strategic Defense Command (USASDC) advanced material systems. The material examined covers the period from 1975 to mid-1984. In addition to raw material cost projection analysis, the document also presents data on the mechanical, thermal and physical properties of general interest advanced metal matrix and polymer matrix systems.
Author (GRA)

N86-26386# BDM Corp., Huntsville, Ala.
ADVANCED MATERIALS RESEARCH STATUS AND REQUIREMENTS. VOLUME 2, APPENDIX: MATERIAL PROPERTIES DATA REVIEW Final Report
Jonathan A. Lee and Donald L. Mykkanen Mar. 1986 199 p
(Contract DASG60-85-C-0087)
(AD-A165339; BDM/H-86-0115-TR-Vol-2) Avail: NTIS HC A09/MF A01 CSCL 11/6

This document describes the status and requirements of advanced composite materials which are being considered for engineering structural applications to U.S. Army Strategic Defense Command (USASDC) advanced material systems. The material examined covers the period from 1975 to mid-1984. In addition to raw material cost projection analysis, the document also presents data on the mechanical, thermal and physical properties of general interest advanced metal matrix and polymer matrix systems.
Author (GRA)

N86-26387# New Mexico Univ., Albuquerque. Dept. of Geology.
HIGH RESOLUTION IMAGING OF BORON CARBIDE MICROSTRUCTURES
I. D. R. Mackinnon, T. Aselage (Sandia National Labs., Albuquerque, N. Mex.), and S. B. VanDeusen Aug. 1985 13 p Presented at the International Conference on the Physics and Chemistry of Boron and Boron-rich Borides Prepared in cooperation with Sandia National Labs.
(Contract DE-AC04-76DP-00789)
(DE86-001751; SAND-85-1432C; CONF-850786-9) Avail: NTIS HC A02/MF A01

Two samples of boron carbide have been examined using high resolution transmission electron microscopy (HRTEM). A hot-pressed B13C2 sample shows a high density of variable width twins normal to (10*1). Subtle shifts or offsets of lattice fringes along the twin plane and normal to approx.(10*5) were also observed. A B4C powder showed little evidence of stacking disorder in crystalline regions. DOE

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

N86-26388*# San Diego State Univ., Calif. Dept. of Electrical and Computer Engineering.
MEASUREMENTS OF HO2 CHEMICAL KINETICS WITH A NEW DETECTION METHOD Semiannual Status Report, 1 Dec. 1985 - 31 May 1986
Long C. Lee and Masako Suto 1986 39 p refs
(Grant NAGw-661)
(NASA-CR-176826; NAS 1.26:176826) Avail: NTIS HC A03/MF A01 CSCL 07D

Research for the period from December 1, 1985 to May 31, 1986 is discussed, i.e., the reaction rate constant of HO2+O3 has been measured with a discharge-flow-tube apparatus. The HO2 radical was detected by the OH(A-X) photofragment emission produced from photodissociative excitation of HO2 at 147 nm. In the meantime, the optical emissions produced by the vacuum ultraviolet excitation of chemical species in the flow tube were investigated and used to examine the possibility for their interference with the HO2 detection. The research results are summarized below. Author

N86-26389# Evans (Charles) and Associates, San Mateo, Calif.
INVESTIGATION AND DEVELOPMENT OF ADVANCED SURFACE MICROANALYSIS TECHNIQUES AND METHODS Final Technical Report, 1 Apr. 1983 - 30 Sep. 1985
Robert W. Odom and Charles A. Evans, Jr. 1 Apr. 1983 125 p refs
(Contract MDA903-83-C-0099; ARPA Order 4713)
(AD-A163616) Avail: NTIS HC A06/MF A01 CSCL 07/4

The goals of this research program were two-fold: (1) Improve the sensitivity and quantitative capabilities of existing surface microanalysis techniques operating in the 1 to 150 micrometer lateral dimension regime; and (2) Investigate and evaluate techniques for obtaining trace level analyses of materials down to the 0.1 micrometer lateral dimension. This research program produced several results in the advancement of quantitation and detection limits of the two most widely used microanalytical techniques, scanning Auger microscopy (SAM) and secondary ion mass spectrometry (SIMS). This concept was developed and tested on the characterization of borophosphosilicate glass (BPSG) passivations and intermetal dielectrics. Three approaches were evaluated for the improvement of trace element detection limits. The first was to determine whether the laser enhancement concepts of resonant and nonresonant multiphonon ionization. The second approach to improved trace element detection limits was to thoroughly evaluate the analytical methodologies of specific impurity/matrix combinations relating to a particular technology. The third approach for enhanced trace component analysis was the evaluation of evolving microanalytical techniques which provide these improved quantitation or detection limits. GRA

N86-26390# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
NUMERICAL SIMULATION OF TURBULENT FLAMES USING VORTEX METHODS Annual Progress Report, 1 Sep. 1984 - 31 Aug. 1985
Ahmed F. Ghoniem 1 Oct. 1985 14 p refs
(Grant AF-AFOSR-0356-84)
(AD-A164080; AFOSR-85-1238TR; APR-1) Avail: NTIS HC A02/MF A01 CSCL 21/2

Vortex schemes for direct numerical simulation of turbulence are developed to study the propagation and stability of turbulent flames. Attention is focused on the construction of accurate and efficient computational algorithms that are easily extendable to three dimensional reacting flow at high Reynolds numbers. A

Lagrangian vortex scheme, which incorporates stochastic simulation of diffusion, was used to obtain solutions for a recirculating flow and a mixing layer. Results showed good agreement with experimental data at intermediate Reynolds number for the first case, and was used to establish the convergence of the numerical method, the sources of errors and the appropriate scheme to improve the accuracy efficiently. For the mixing layer, the simulation predicted the average velocity and the streamwise fluctuations accurately, but overpredicted the cross-stream fluctuation, indicating that the latter are governed by the three dimensional effects. The response of the layer to harmonic modulations was analyzed revealing the nature of the flow and indicating how entrainment can be enhanced in shear flow. The relationship between the flow instability and the combustion stabilization in both cases indicated the premixed flames have a narrow range of stable existence in terms of the equivalence ratio. GRA

N86-26391# Air Force Geophysics Lab., Hanscom AFB, Mass.
THEORETICAL N2-, 02- AND AIR-BROADENED HALFWIDTHS OF OZONE CALCULATED BY QUANTUM FOURIER TRANSFORM THEORY WITH REALISTIC COLLISION DYNAMICS
Robert R. Gamache, Richard W. Davies, and Laurence S. Rothman 31 Dec. 1985 6 p
(AD-A163276; AFGL-TR-85-0340) Avail: NTIS HC A02/MF A01 CSCL 07/4

Collision broadened halfwidths of ozone are evaluated with nitrogen, oxygen, and air as the perturbing gases. It is important to consider more realistic collision dynamics in the calculations. By replacing the classical path trajectories by linear trajectories with constant velocities chosen to give the equations of motion exact to first order in time we develop the interruption function in terms of the actual distance of closest approach determined by the intermolecular potential and the velocity at this point. This improvement to the theory results in halfwidths which are in good agreement with experimental measurements. The temperature dependence of the halfwidth has been determined for 126 transactions for N2-broadening and for 10 transitions for 02-broadening. Comparison with experimental measurements is given. GRA

N86-26392# Pittsburgh Univ., Pa. Dept. of Chemistry.
DF VIBRATIONAL RELAXATION Final Report, 1 Sep. 1982 - 31 Aug. 1985
L. S. Dzelzkalns 31 Aug. 1985 28 p
(Contract N00014-82-K-0675)
(AD-A163421) Avail: NTIS HC A03/MF A01 CSCL 07/4

This report presents experimental results of the vibrational relaxation of DF(2 < or = v < or = 4) and DF(9 < or = v < or = 12). The fast flow infrared chemiluminescence method was used to determine vibrational relaxational rate constants for the processes DF(2 < or = v < or = 4) + Carbon Monoxide, Hydrogen Fluoride, Deuterium Fluoride, Nitrous Oxide, Carbon Tetrafluoride, and Sulfur Hexafluoride and DF(9 < or = v < or = 12) + Nitrogen, CO, HF, DF, Carbon Dioxide, and N2O. These are the first measurements of relaxation rate constants for the high vibrational states of DF. They are combined with low v-level data in order to gain additional insight into fundamental energy transfer questions such as the origin of the unusually strong v-dependences. GRA

N86-26393# Colorado State Univ., Fort Collins. Dept. of Chemistry.
MOLECULAR JET STUDY OF SOLVATION OF PYRAZINE BY SMALL HYDROCARBONS
J. Wanna and E. R. Bernstein 19 Mar. 1985 35 p refs
(Contract N00014-79-C-0647)
(AD-A164583) Avail: NTIS HC A03/MF A01 CSCL 07/4

Supersonic molecular jet two-color time of flight mass spectroscopy studies are reported for pyrazine solvated by methane, ethane, and propane. The results parallel those obtained for benzene and toluene solvated by these molecules. The presence of nitrogen atoms and lone pair electrons in the aromatic system has only a small effect on the cluster structure. Lennard-Jones potential calculations are presented along with the experimental data. Cluster shifts and binding energies are reported and correlated with geometries. The nucleation process for cluster formation appears to involve solvent dimers, as was found for the aromatic hydrocarbon systems. GRA

N86-26394# Colorado State Univ., Fort Collins. Dept. of Chemistry.
MOLECULAR JET STUDY OF VANDERWAALS COMPLEXES OF FLEXIBLE MOLECULES: N-PROPYL BENZENE SOLVATED BY SMALL ALKANES
K. S. Law and E. R. Bernstein 1 Apr. 1985 45 p refs
(Contract N00014-79-C-0647)
(AD-A164600; TR-18) Avail: NTIS HC A03/MF A01 CSCL 07/4

A combination of atom-atom potential calculations and experimental molecular jet spectroscopic studies is used to elucidate the geometry and binding energy of n-propul benzene/methane, ethane, and propane clusters. Two color time-of-flight mass spectroscopy data and calculations are presented for both trans and gauche configurations of n-propul benzene with up to three hydrocarbon molecules of solvation. Cluster shifts and geometry are treated in detail for the observed and calculated systems. Solvation, as observed in the clusters, seems to have little effect on the geometry of the solute in this instance. Alkyl chain motion is also discussed for the n-propyl benzene isolated molecule. GRA

N86-26395# United Technologies Research Center, East Hartford, Conn.
CARS DIAGNOSTICS OF HIGH PRESSURE COMBUSTION. 2. MEASUREMENTS OF NO, H2O AND HIGH PRESSURE FLAMES Final Report, 10 Oct. 1982 - 20 Dec. 1985
J. H. Stufflebeam and J. A. Shirley Dec. 1985 90 p refs
(Contract DAAG29-83-C-0001)
(AD-A164610; UTRC/R85-956328-F; ARO-18920.3-CH) Avail: NTIS HC A05/MF A01 CSCL 21/2

Spectroscopic investigations into the coherent anti-Stokes Raman spectroscopy (CARS) spectra of NO and H2O were conducted and the capability of CARS for diagnostics of high pressure flames examined. CARS is a remote laser diagnostic technique for temperature and species measurements in hostile combustion environments. As such it possesses considerable relevance to the Army in the general areas of ballistics and propulsion. This report describes the results of investigations conducted into the effects of high pressure, specifically the phenomenon of collisional narrowing, on CARS spectra from which temperature and density information derive. Experimental studies of CARS spectra were conducted in NO in a heated, high pressure cell over the range 300K to 800K, 1-33 atm, in H2O from 500K to 1000K, 5-30 atm and in a high pressure, premixed CO/air flame from 1-15 atm. The CARS spectra obtained were used to evaluate the CARS computer code. In addition, a new technique, termed dual broadband CARS, was developed which permits the simultaneous detection of a multiplicity of chemical species. This approach removes the nominal limitation on CARS of interrogating just a single constituent at a time. This technique should prove invaluable in the transient environments of combustion p High pressure combustion diagnostics; Collisional narrowing; Water vapor; Nitric oxide; High pressure premixed flame; and Polarization suppression. GRA

N86-26396# Colorado Univ., Boulder.
A FUNDAMENTAL MATHEMATICAL THEORY FOR THERMAL EXPLOSIONS IN RIGID SOLIDS AND IN GASES Final Report, 1 Mar. 1982 - 21 Jul. 1985
J. Bebernes and D. R. Kassoy 31 Jan. 1986 31 p refs
(Contract DAAG29-82-K-0069)
(AD-A164692; CUCOMB-2; ARO-18906.23-MA) Avail: NTIS HC A03/MF A01 CSCL 21/2

This research project has emphasized the formulation of rational mathematical models for transient and steady combustion processes. In particular, thermal explosion, shock wave initiation and high speed combustion waves have been examined. In each

case the describing mathematical system is analyzed using both formal and constructive techniques. The former are employed to consider issues of existence and uniqueness, solution bounds and general trajectory properties. Constructive solution development is based on a combination of asymptotic and numerical methods. This hybrid approach to the study of combustion problems has permitted us to develop both a rigorous and quantitative understanding of complex, initial-boundary value problems. GRA

N86-26397# Office of Naval Research, Arlington, Va.
STRUCTURAL CHEMISTRY OF ENERGETIC COMPOUNDS Annual Progress Report, 1 Oct. 1984 - 1 Oct. 1985
Richard Gilardi, Clifford George, and Judith L. Flippen-Anderson 1 Oct. 1985 93 p
(AD-A164813) Avail: NTIS HC A05/MF A01 CSCL 07/4

Structural characterization of 16 energetic materials and precursors was performed by X-ray diffraction. The trinitro and tetranitro tetraazabicyclo (3.3.0) octanes examined, compounds D and E, are significantly more dense than had been predicted. The crystal structure analysis showed that the increase in density is due to intramolecular crowding rather than extraordinary packing efficiencies which were at normal values of 0.73 and 0.75 respectively. GRA

N86-26398# Emory Univ., Atlanta, Ga. Dept. of Chemistry.
DATA ANALYSIS FOR MULTIDIMENSIONAL LUMINESCENCE Interim Technical Report
Sharon L. Neal, Gabor Patonay, Mark P. Thomas, and Isiah M. Warner 10 Feb. 1986 31 p
(Contract N00014-83-K-0026)
(AD-A164866; EMORY/DC/TR/10) Avail: NTIS HC A03/MF A01 CSCL 07/5

The application of digital analysis and reduction methods to multidimensional luminescence measurements is reviewed. The applicability and performance of linear, frequency domain and optimization methods is discussed. The range of problems being solved by these methods is also reported. Linear methods have been developed to the greatest extent. Frequency domain and optimization techniques are being used more often as the need for digital analysis methods increases. GRA

N86-26399# Emory Univ., Atlanta, Ga. Dept. of Chemistry.
BIOANALYTICAL APPLICATIONS OF FLUORESCENCE QUENCHING Interim Technical Report
Chu-Ngi Ho, Gabor Patonay, and Isiah M. Warner 10 Feb. 1986 20 p refs
(Contract N00014-83-K-0026)
(AD-A164867; EMORY/DC/TR/8) Avail: NTIS HC A02/MF A01 CSCL 06/1

Bioanalytical applications of fluorescence quenching are described. Both static and dynamic quenching processes, as applied to biochemistry, are reviewed. New developments and future trends of research in the area are discussed with regard to improved measurements. GRA

N86-26400# Ballistic Research Labs., Aberdeen Proving Ground, Md.
AIR COMPRESSION HEATING IGNITION OF HIGH EXPLOSIVES IN THE LAUNCH ENVIRONMENT
John Starkenberg, Lewis H. Ervin, and Doenee L. McFadden Feb. 1986 34 p
(AD-A164961; BRL-TR-2709) Avail: NTIS HC A03/MF A01 CSCL 19/1

Compressive heating ignition has been the subject of an extensive analytical and experimental study at the Ballistic Research Laboratory. The experimental investigation was conducted using an apparatus referred to as the activator, originally designed at Picatinny Arsenal as a laboratory-scale artillery setback simulator. Several explosives have now been tested. These are TNT, composition-B (comp-B), composition A3 (comp-A3) type II, R8151 (German formulation for the 120 mm round), LX-14, and EARK-25 (an experimental intermolecular explosive). Pressurization rate and cavity size are the principal parameters governing compressive heating ignition. Although ignition may be inhibited by limiting the peak pressure, this did not appear to occur in the activator. Studies of precompression of both cut and polished and as cast surfaces indicated that the state of the explosive surface grossly affects sensitivity to this ignition mechanism. Sensitivity is greater for surfaces which have been precompressed. Geometries which generate convergent airflow yield ignition with milder stimuli than are required with planar geometries. TNT was found to be more sensitive than comp-B when both were precompressed. Comparison of unprecompressed explosives using bubble tests showed that TNT was less sensitive that comp-B and indicated that precompression more effectively seals TNT surfaces. GRA

N86-26401# Georgia Inst. of Tech., Atlanta. School of Geophysical Sciences.
OPTICAL ABSORPTION CHARACTERISTICS OF AEROSOLS Final Report, 26 Jan. 1982 - 30 Jun. 1985
E. M. Patterson 11 Sep. 1985 35 p
(Contract F19628-82-K-0021)
(AD-A165216; AFGL-TR-85-0204) Avail: NTIS HC A03/MF A01 CSCL 07/4

The absorption of well documented, highly absorbing submicron aerosols has been measured by means of diffuse reflectance and diffuse transmission techniques. The intent of these measurements was to compare the different techniques and to provide calibration of these absorption measurements in terms of aqueous transmission measurements. These measurements indicate that there is a consistency among the absorption techniques that the differences between absorption in an aqueous and in an air suspension need to be considered in calibrations of absorption techniques, and that the diffuse transmission and diffuse reflectance measurements using the dilution technique appear to yield consistent results. GRA

N86-26402# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
ELECTRODE PROCESSES IN POROUS ELECTRODES Final Technical Report, Sep. 1984 - Nov. 1985
T. Katan, P. J. Carlen, and J. R. Driscoll 26 Nov. 1985 11 p
(Contract N00014-80-C-0403)
(AD-A165410; LMSC-F104470) Avail: NTIS HC A02/MF A01 CSCL 07/4

This is the final technical report for an ONR contract. The scope of the effort for this period was to address novel methods of investigation of silver electrodes in order to better understand the chemical and physical processes which occur during charge and discharge. Three areas of study were covered by this effort. The first was the development of a mass spectrometric procedure to determine the distribution of silver (I) oxide and silver (II) oxide in a silver electrode at any stage of the charge-discharge process. The second was the development of a rapid analytical technique for the determination of silver (III) oxide in a silver electrode. The third was a preliminary study of the application of acoustic analysis to give a more complete understanding of the processes occurring during charge and discharge of silver electrodes. The results of these investigations are detailed in this report. GRA

N86-26403# Boston Univ., Mass. Dept. of Chemistry.
SPECTROSCOPIC INVESTIGATIONS OF ORGANIC MOLECULES ON GRAPHITE SURFACES Final Report, 1 Jul. 1982 - 31 Dec. 1985
Richard H. Clarke 26 Feb. 1986 5 p
(Contract DAAG29-82-K-0124)
(AD-A165431; ARO-19141.3-CH) Avail: NTIS HC A02/MF A01 CSCL 07/4

The research program conducted over the past three years under ARO sponsorship focused on the spectroscopic investigation of polycyclic aromatic molecules adsorbed onto the surface of graphite. The overall aim of the investigation was to characterize the structural features of the adsorbed complex and to identify the nature of the interactions which stabilize them. Our approach was to examine a series of prototypical aromatic molecules bound to highly oriented pyrolytic graphite by optical, magnetic resonance,

and Raman spectroscopy. Results in several areas of significance were obtained in the course of the research program. In summary, these were: observance of optical and ODMR spectra of photoexcited quinoline and quinoxaline on graphite; observance of resonance Raman scattering from chlorophyll on graphite; observance of ODMR from chlorophyll on graphite; determination of the chlorophyll geometry on the graphite surface; demonstration of the feasibility of Raman-detected ODMR on surfaces. GRA

N86-26404# Air Force Geophysics Lab., Hanscom AFB, Mass.
STUDIES OF NEGATIVE ION REACTIONS: SOLVATED IONS AND STRONG ACIDS
John F. Paulson, Albert A. Viggiano, Michael Henchman, and Fred Dale 7 Mar. 1986 7 p
(AD-A165484; AFGL-TR-86-0049) Avail: NTIS HC A02/MF A01 CSCL 07/4

The reactions of several negative ion species with up to three solvate molecules have been studied in a variable temperature selected ion flow tube. The reactions include association of some species of interest in the stratosphere and some proton transfer reactions of the strong and super acids. GRA

N86-26405# California Univ., Berkeley. Lawrence Berkeley Lab.
CARBON MONOXIDE INDUCED ORDERING OF ADSORBATES ON THE Rh(111) CRYSTAL SURFACE
C. M. Mate, B. E. Bent, and G. A. Somorjai Sep. 1985 9 p Presented at the 4th Conference on Vibrations at Surfaces, Bowess-on-Windermere, England, 15-19 Sep. 1985 Submitted for publication
(Contract DE-AC03-76SF-00098)
(DE86-004104; LBL-20360; CONF-8509183-2) Avail: NTIS HC A02/MF A01

It is found that the coadsorption of CO with ethylidyne, propylidyne, acetylene, fluorobenzene, benzene, and sodium on the Rh(111) surface induces ordering in the adsorbed overlayer. This phenomenon was studied using high resolution electrol energy loss spectroscopy (HREELS), low energy electron diffraction (LEED), and thermal desorption spectroscopy (TDS). The HREELS indicates that the adsorbates maintain their molecular integrity when coadsorbed with CO though a change in adsorption site sometimes occurs. In all cases, the C-O stretching frequency of coadsorbed CO is substantially reduced from that of CO adsorbed on clean Rh(111) and ranges from 1410 cm(-1) for CO coadsorbed with sodium to 1790 cm(-1) for CO coadsorbed with ethylidyne. DOE

N86-26406# Texas A&M Univ., College Station. Dept. of Chemistry.
PHOTOELECTROCHEMICAL REDUCTION OF CARBON DIOXIDE Annual Report, May 1984 - Apr. 1985
K. Chandrasekaran and J. O. Bockris Jul. 1985 68 p refs
(Contract GRI-5084-260-0982)
(PB86-157864; GRI-85/0176) Avail: NTIS HC A04/MF A01 CSCL 07D

Surface states at semiconductor-electrolyte interfaces were determined under illumination for CdTe, GaP and Si. The faradaic reaction involved was photoelectrochemical reduction of CO2 on CdTe and GaP and H2 evolution on Si. New equivalent circuits are proposed to represent the semiconductor-electrolyte interface under illumination. Surface state density is calculated per unit area at a given bias potential from integral surface state capacitance. Surface states at Si - aqueous H2SO4 interface act as recombination centers for the photogenerated electron hole pair annihilation. Surface states at CdTe-electrolyte interface act as faradaic mediators for CO2 reduction. It is proposed that adsorbed ions and radicals induce surface states. Potential of zero charge was determined for semiconductor electrolyte interfaces using Herbert pendulam and the results are discussed for several interfaces. GRA

N86-26407# Yale Univ., New Haven, Conn.
IN SITU MONITORING OF ELECTROCHEMICAL REACTIONS BY SURFACE ENHANCED RAMAN SCATTERING Annual Report, 1 Jul. 1984 - 30 Jun. 1985
R. K. Chang and V. E. Henrich Nov. 1985 23 p
(Contract GRI-5083-260-0795)
(PB86-157500; GRI-85/0262) Avail: NTIS HC A02/MF A01 CSCL 07D

Surface enhanced Raman scattering (SERS) was applied in investigating the nature of the water adsorbates and the protonation of Ag-oxides on Ag electrodes immersed in various electrolytes and undergoing oxidation-reduction cycles. The vibrational frequency of the O-D stretching mode of water adsorbates was determined for the two possible orientations (oxygen pointing away from or toward the Ag surface) and the two possible species (deuterium or hydrogen) on the other bond. Chemical reactions on Au colloids and Ag powder were also investigated as a first step toward the eventual usage of SERS for real-time monitoring of adsorbate species on industrial catalysts. To better quantify the SERS on metallic microstructures, e-beam lithography was used to produce microstructure arrays of uniform size, shape, and separation. Significant progress was made in measuring the surface enhanced inelastic scattering in the low frequency (0-250/cm) by incorporating a 12 vapor cell as a prefilter in front of the optical multichannel analyzer. GRA

N86-26408# Dow Corning Corp., Midland, Mich.
INVESTIGATION OF STRUCTURE-PERMEABILITY RELATIONSHIPS OF SILICONE POLYMER MEMBRANES Annual Interim Report, Oct. 1984 - Sep. 1985
K. Venkataraman, S. A. Stern, and J. E. Mark Oct. 1985 223 p refs Prepared in cooperation with Syracuse Univ., N.Y. and Cincinnati Univ., Ohio
(Contract GRI-5082-260-0666)
(PB86-157179; GRI-85/0246) Avail: NTIS HC A10/MF A01 CSCL 07D

An experimental apparatus was set up to determine the chemical and thermal stability of various silicone membranes to NH3, H2S and COS. Root-mean-square-end-to-end distance measurements were completed for (MePrSiO)x and (MeHxSiO)x. The electronic and conformation properties of Si-O-Si bond were studied using molecular orbitals (MO). Gas permeability and solubility data obtained indicate that the solubility and hence the permeability decreases with decreasing critical temperature of the penetrant except in the case of He and H2. The substitution of bulkier functional groups in the side-chains of a silicone polymer results in a decrease in the gas permeability of the polymer, due mainly to a decrease in the diffusivity of the penetrant in the polymer. The selectivity of the polymer is not affected by the substitution of bulkier functional groups in the side chain. A correlation was obtained for the solubility coefficient in Henry's law limit for different penetrants in a given silicone polymer. GRA

N86-26409# National Bureau of Standards, Gaithersburg, Md. Office of Standard Reference Data.
STANDARD REFERENCE DATA PUBLICATIONS, 1964-1984
J. C. Sauerwein and G. R. Dalton Dec. 1985 147 p
(PB86-155587; NBS-SP-708; LC-85-600607) Avail: NTIS HC A07/MF A01; also available SOD $5.00 as SN003-003-02705-7 CSCL 07D

The National Bureau of Standards' Office of Standard Reference Data manages a network of data centers that prepare evaluated data bases of physical and chemical properties of substances. Data bases are available in printed form, on magnetic tapes and through on-line computer networks. This document provides a comprehensive list of the products available from the National Standard Reference Data System (NSRDS) for the years 1964 to 1984, including indexes qualified by author, material, and property terms. Ordering information and current prices can be found at the end of this document. GRA

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N86-26410*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SURFACE FILM EFFECTS ON DROP TUBE UNDERCOOLING STUDIES Final Report
E. C. Ethridge and W. F. Kaukler (Alabama Univ., Huntsville) Apr. 1986 37 p refs
(NASA-TM-86547; NAS 1.15:86547) Avail: NTIS HC A03/MF A01 CSCL 11F

The effects of various gaseous atmospheric constituents on drop-tube solidified samples of elemental metals were examined from a microstructural standpoint. All specimens were prepared from the purest available elements, so effects of impurities should not account for the observed effects. The drop-tube gas has a definite effect on the sample microstructure. Most dramatically, the sample cooling rate is effected. Some samples receive sufficient cooling to solidify in free fall while others do not, splating at the end of the drop tube in the sample catcher. Gases are selectively absorbed into the sample. Upon solidification gas can become less soluble and as a result forms voids within the sample. The general oxidation/reduction characteristics of the gas also affect sample microstructures. In general, under the more favorable experimental conditions including reducing atmospheric conditions and superheatings, examination of sample microstructures indicates that nucleation has been suppressed. This is indicated by underlying uniform dendrite spacings throughout the sample and with a single dendrite orientation through most of the sample. The samples were annealed yielding a few large grains and single or bi-crystal samples were commonly formed. This was especially true of samples that were inadvertently greatly superheated. This is in contrast with results from a previous study in which surface oxides were stable and contained numerous sites of nucleation. The number of nucleation events depends upon the surface state of the specimen as determined by the atmosphere and is consistent with theoretical expectations based upon the thermodynamic stability of surface oxide films. Oxide-free specimens are characterized by shiny surfaces, with no observable features under the scanning electron microscope at 5000X. Author

N86-26411# Aeronautical Research Labs., Melbourne (Australia). Materials Research Lab.
SLOW STRAIN RATE TESTING OF HIGH STRENGTH LOW-ALLOY STEELS: A TECHNIQUE FOR ASSESSING THE DEGREE OF HYDROGEN EMBRITTLEMENT PRODUCED BY PLATING PROCESSES, PAINT STRIPPERS AND OTHER AIRCRAFT MAINTENANCE CHEMICALS
W. J. Pollock and C. Grey Dec. 1985 42 p
(AR-004-060; ARL-MAT-R-118) Avail: NTIS HC A03/MF A01

A slow strain rate tensile test which can be used to quantify rapidly in a statistically rigorous manner the severity of hydrogen embrittlement produced in high strength 4340 steel by paint strippers and plating processes is demonstrated. The results of multiple slow strain rate tests conducted at a crosshead displacement rate of .0002 mm/s using notched specimens in various paint strippers show that a minimum mean fracture stress and maximum standard deviation can be defined that correlates with the pass/fail criterion in standard notched C-ring tests. The advantages of using a slow strain rate test as a viable alternative to existing standard methods for hydrogen embrittlement testing are discussed. Author

N86-26412*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OXIDATION AND EMITTANCE OF SUPERALLOYS IN HEAT SHIELD APPLICATIONS
Karl E. Wiedemann (Analytical Services and Materials, Inc., Hampton, Va.), Ronald K. Clark, and Jalaiah Unnam Jun. 1986 20 p Presented at the TMS-AIME Fall Meeting, Toronto, Ontario, 13-17 Oct. 1985
(NASA-TP-2578; L-16104; NAS 1.60:2578) Avail: NTIS HC A02/MF A01 CSCL 11F

Recently developed superalloys that form alumina coatings have a high potential for heat shield applications for advanced aerospace vehicles at temperatures above 1095C. Both INCOLOY alloy MA 956 (of the Inco Alloys International, Inc.), an iron-base oxide-dispersion-strengthened alloy, and CABOT alloy No. 214 (of the Cabot Corporation), an alumina-forming nickel-chromium alloy, have good oxidation resistance and good elevated temperature strength. The oxidation resistance of both alloys has been attributed to the formation of a thin alumina layer (alpha-Al2O3) at the surface. Emittance and oxidation data were obtained for simulated Space Shuttle reentry conditions using a hypersonic arc-heated wind tunnel. The surface oxides and substrate alloys were characterized using X-ray diffraction and scanning and transmission electron microscopy with an energy-dispersive X-ray analysis unit. The mass loss and emittance characteristics of the two alloys are discussed. Author

N86-26413*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ANALYSIS OF THE PHYSICAL ATOMIC FORCES BETWEEN NOBLE GAS ATOMS, ALKALI IONS AND HALOGEN IONS
John W. Wilson, John H. Heinbockel (Old Dominion Univ., Hampton, Va.), and R. A. Outlaw Jun. 1986 37 p
(NASA-TP-2568; L-16093; NAS 1.60:2568) Avail: NTIS HC A03/MF A01 CSCL 07D

The physical forces between atoms and molecules are important in a number of processes of practical importance, including line broadening in radiative processes, gas and crystal properties, adhesion, and thin films. The components of the physical forces between noble gas atoms, alkali ions, and halogen ions are analyzed and a data base for the dispersion forces is developed from the literature based on evaluations with the harmonic oscillator dispersion model for higher order coefficients. The Zener model of the repulsive core is used in the context of the recent asymptotic wave functions of Handler and Smith; and an effective ionization potential within the Handler and Smith wave functions is defined to analyze the two body potential data of Waldman and Gordon, the alkali-halide molecular data, and the noble gas crystal and salt crystal data. A satisfactory global fit to this molecular and crystal data is then reproduced by the model to within several percent. Surface potentials are evaluated for noble gas atoms on noble gas and salt crystal surfaces with surface tension neglected. Within this context, the noble gas surface potentials on noble gas and salt crystals are considered to be accurate to within several percent. Author

N86-26414*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HEAT TREATMENT FOR SUPERALLOY Patent Application
Fredric H. Harf, inventor (to NASA) Filed 24 Feb. 1986 11 p
(NASA-Case-LEW-14262-1; NAS 1.71:LEW-14261-1; US-Patent-Appl-SN-832296) Avail: NTIS HC A02/MF A01 CSCL 11F

A cobalt-free nickel-base superalloy composed of in weight % 15 Cr - 5 Mo - 3.5 Ti - 4 Al - 0.07 (max) C - remainder Ni is given a modified heat treatment. With this heat treatment the cobalt-free alloy achieves certain of the mechanical properties of the corresponding cobalt-containing nickel-base superalloy at 1220 F (650 C). Thus, strategic cobalt can be replaced with nickel in the superalloy. NASA

N86-26415# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FERROMAGNETIC DIELECTRIC SUBSTANCE
Yu. G. Borzyak, N. N. Oster-Volkov, A. I. Rolik, and A. I. Yakovlev 17 Dec. 1985 5 p refs Transl. into ENGLISH from Russian Patent no. 169706 (17 Mar. 1965) p 1-2
(AD-A163214; FTD-ID(RS)T-1203-85; FTD-ID(RS)T-1227-85) Avail: NTIS HC A02/MF A01 CSCL 11/6

The claim of this invention is a ferromagnetic dielectric substance on the basis of a magnetically soft iron powder and

polymer thermoreactive compound as the binder, which differs in that for the purpose of ensuring high heat resistance and mechanical strength, the compound indicated consists of a furan epoxy resin with the addition of a hardener (hexamethylene diamine or polyethylene polyamine) and a fiberglass admixture. GRA

N86-26416# Illinois Univ., Urbana. Dept. of Metallurgy and Mining Engineering.
HYDROGEN EMBRITTLEMENT OF NICKEL: MODELING OF THE EFFECT OF DIFFUSIVE SEGREGATION OF HYDROGEN ON INTERGRANULAR FRACTURE
D. H. Lassila and H. K. Birnbaum Jan. 1986 15 p
(Contract N00014-83-C-0468)
(AD-A163415) Avail: NTIS HC A02/MF A01 CSCL 11/6

Grain boundary fracture of hydrogen-charged nickel was studied under test conditions where hydrogen is essentially immobile. Prior to testing, hydrogen was allowed to diffuse during aging treatments. Experimental results show that the transition in the fracture mode from ductile rupture to intergranular is strongly dependent on aging temperature and time as well as initial bulk hydrogen concentration. Analytical modeling of these dependencies using established thermodynamic and kinetic relationships indicates that grain boundary hydrogen concentration controls the fracture mode of hydrogen-charged nickel at low temperatures. GRA

N86-26417# Southwest Research Inst., San Antonio, Tex. Fuels and Lubricants Research Facility.
THE INHIBITION OF VAPOR-PHASE CORROSION. A REVIEW Interim Report, 1 Jul. - 30 Sep. 1985
George E. Fodor Oct. 1985 64 p
(Contract DAAK70-85-C-0007)
(AD-A163430; BFLRF-209) Avail: NTIS HC A04/MF A01 CSCL 11/6

This report documents a limited literature review on vapor phase corrosion and its inhibition. The direct cost of atmospheric corrosion of metals and alloys in the United States alone has been estimated to be between $5 billion to over $20 billion annually. This atmospheric corrosion, known by some researchers as vapor phase corrosion (VPC), is due to the individual and combined action of oxygen, moisture, and atmospheric pollutants. Additional contributors to VPC are rain, snow, dust, soot, ash, wind, and radiation (light, heat, etc.). The rate of VPC may be accelerated by both acids and bases, depending upon the metal. Rosenfeld showed that the mechanism of this attack is electrochemical, in which the electrolyte is composed of a thin film of humidity on the surface of the metal. Detrimental effects caused by photochemical reactions of sulfur dioxide and nitrogen oxides have been demonstrated. Classical methods of protecting equipment from atmospheric attack include: (1) using coating materials or paints, and (2) alloying the metal to increase its resistance to corrosion. An effective and relatively inexpensive method of controlling VPC in closed environments is through the use of vapor phase corrosion inhibitors (VCI). These materials, while having an appropriate vapor pressure, possess high passivating properties, strong tendencies toward surface adorption, and the ability to form a comparatively strong and stable bond with the metal surface. GRA

N86-26418# Lehigh Univ., Bethlehem, Pa. Dept. of Metallurgy and Materials Engineering.
CRACK PROPAGATION IN POWDER METALLURGY HOT ISOSTATICALLY PRESSED NICKEL-BASED ALLOY Annual Report, 1 Jan. - 31 Dec. 1984
Richard W. Hertzberg 5 May 1985 28 p refs
(Grant AF-AFOSR-0029-83)
(AD-A164587; AFOSR-85-0672TR) Avail: NTIS HC A03/MF A01 CSCL 11/6

The room temperature threshold fatigue behavior of P/M HIP'd L.C. Astroloy has been examined. Material with grain sizes ranging from 5 micrometers to 50 micrometers has been tested to investigate the influence of grain size on the threshold response. In disc compact tension specimens grain size is observed to have little influence on the threshold values; in contrast tests conducted in four point bend specimens exhibit lower threshold values and display a dependence on grain size with larger grain sizes giving higher threshold values. Consideration has also been given to the growth of short cracks under cyclic loading at low stress intensities. The data reveal that under these conditions short cracks propagate at a consistently faster rate than long cracks subject to the same nominal stress intensity. Analytical work has been conducted which suggests that this behavior may be rationalized in terms of a more appropriate driving force for crack extension. Detailed microstructural information has been collected which identifies the major second phase particles present in the alloy. The effect of simple heat treatments on the distribution of these particles has been observed to be negligible. GRA

N86-26419# Lehigh Univ., Bethlehem, Pa. Center for Surface and Coatings Research.
CORROSION CONTROL THROUGH A BETTER UNDERSTANDING OF THE METALLIC SUBSTRATE/ORGANIC COATING/INTERFACE Annual Report, 1 Oct. 1984 - 30 Sep. 1985
Henry Leidheiser, Jr., Egene M. Allen, Frederick M. Fowkes, Richard D. Granata, and Jack F. McIntyre 31 Jan. 1986 175 p
(Contract N00014-79-C-0731)
(AD-A164734; AR-6) Avail: NTIS HC A08/MF A01 CSCL 11/6

The contents of this report include: Sensitive Test for Water under an Organic Coating; The Effect of Temperature and Alkali Metal Cation on the Cathodic Delamination of Polybutadiene from Steel; Acid Base Effects in Glass/Bead Phenoxy Model Coating Systems; Surface Acidity of Ferric Oxides Studied by Flow Microcalorimetry; Inhibition of Iron Corrosion by Carboxylates in the Presence of Oxidants; Corrosion Behavior of Steel Pre-Treated with Silanes; Ionic Migration through Organic Coatings and Its Consequences to Corrosion; The Effect of Alkali Metal Hydroxides on the Dissolution Behavior of a Zinc Phosphate Conversion Coating on Steel and Pertinence to Cathodic Delamination; Corrosion beneath Polymeric Coatings on Thin Metal Films as Studied Using Concurrent AC Impedance and Parallel DC Resistance Measurements. GRA

N86-26420# Naval Postgraduate School, Monterey, Calif.
EFFECT OF CHROMIUM ADDITION TO THE LOW TEMPERATURE HOT CORROSION RESISTANCE OF PLATINUM MODIFIED ALUMINIDE COATINGS M.S. Thesis
Mark W. Dust Dec. 1985 77 p
(AD-A164755) Avail: NTIS HC A05/MF A01 CSCL 11/6

Marine gas turbines face many adverse conditions such as reduced fuel quality and a salt environment which present the sulfur, chloride, and sulfates required to initiate and propagate hot corrosion. A particularly severe type of hot corrosion is low temperature hot corrosion (LTHC) encountered at the low temperatures (600 to 750 C) used for low power destroyer operations. Platinum-aluminides have demonstrated great success as protective coatings which delay the onset of high temperature hot corrosion attack (800 to 1000 C). Chromium is known to provide good LTHC resistance. The effect of chromium addition to platinum aluminide coatings was investigated using two different nickel base superalloys, IN-738 (16% Cr) and IN-100 (10% Cr). GRA

N86-26421# Army Armament Research and Development Command, Watervliet, N. Y. Close Combat Armaments Center.
MATERIAL PROPERTY AND FRACTURE TESTING OF 7075-T6 EXTRUDED ALUMINUM Final Technical Report
M. A. Scavullo, J. H. Underwood, J. A. Kapp, and J. J. Zalinka Nov. 1985 27 p
(AD-A164933; AD-E440313; ARCCB-TR-85001) Avail: NTIS HC A03/MF A01 CSCL 19/1

The results of an experimental investigation into the material properties of 7075-T6 extruded aluminum used in the production of sabots for kinetic energy projectiles are presented. A comparison is made of two suppliers' materials, and a test is described that will show a difference exists in the two suppliers' materials. GRA

N86-26422# Martin Marietta Labs., Baltimore, Md.
THE DELAYED FRACTURE OF ALUMINUM ALLOYS Final

Report
Joseph R. Pickens and Timothy J. Langan Oct. 1985 82 p
(Contract N00014-83-C-0380)
(AD-A165203; MML-TR-85-64C) Avail: NTIS HC A05/MF A01 CSCL 11/6

The relationship between susceptibility to stress-corrosion cracking (SCC) and grain boundary (GB) chemistry was investigated in an attempt to elucidate the SCC mechanism in aluminum-zinc-magnesium alloys. Research was performed in two phases: (1) develop a method for inducing intergranular fracture on the actual grain boundary to enable measurement of GB composite by Auger electron spectroscopy (AES), and (2) attempt to relate changes in GB composition to changes in SCC susceptibility. The three methods of inducing intergranular fracture were evaluated: (1) fracture at near-liquid nitrogen temperatures, (2) fracture after pre-exposure to liquid gallium, and (3) fracture after pre-exposure to water vapor-saturated air (WVSA). Fracture after pre-exposure to WVSA (i.e., hydrogen pre-exposure embrittlement: H-PEE) is brittle intergranular and no reaction occurred with the fracture surface, thereby allowing composition to be measured by AES. The H-PEE fracture technique was then used to measure GB compositions for an alloy whose SCC susceptibility was varied by changing either solution heat-treatment temperature (SHT) or aging time. GRA

N86-26423# Rockwell International Corp., Golden, Colo.
CHARACTER OF SILVER LINING
1985 13 p Presented at the ASM Metals Congress - International Conference on Surface Modifications, Toronto, Ontario
(Contract DE-AC04-76DP-03533)
(DE86-001585; RFP-3662; CONF-8510160-9) Avail: NTIS HC A02/MF A01

A study has been done to characterize the structures developed in thin silver coatings deposited by the hot-hollow cathode method. The two variables examined were substrate temperature and deposition rate. Three different structural zones were seen at the different substrate temperatures. Deposition rates of 218, 374, and 684 A/sec were used to determine the effect of rate. Only the coupon coated at 218 A/sec and at 62C had any significant change in structure. DOE

N86-26424# Oak Ridge National Lab., Tenn.
EFFECTS OF RAPIDLY PULSED ION BOMBARDMENT ON MICROSTRUCTURE AND PHASE STABILITY IN A TI-MODIFIED STAINLESS STEEL
E. H. Lee, N. H. Packan, M. B. Lewis, and L. K. Mansur 1985 28 p Presented at the TMS/AIME Fall Meeting, Toronto, Ontario
(Contract DE-AC05-84OR-21400)
(DE86-004790; CONF-8510168-5) Avail: NTIS HC A03/MF A01

A low-swelling Ti-modified austenitic stainless steel has been bombarded with pulsed 4 MeV Ni(++) and in some cases simultaneously with 0.2 to 0.4 MeV He(+) ion beams at 948K over a dose range from 1 to 70 dpa. The interruption periods studied were 60, 1, 10(-3), or 10(-5) s on time with equal off time. At 1 dpa, pulsed irradiation caused interstitial dislocation loops (and subsequent MC precipitates) to be more refined with decreasing pulse periods down to the realm of the vacancy lifetime (10(-1) to 10(-3) s); still faster pulsing at 10(-5) s yielded little difference from steady irradiation. At higher doses, 40 to 70 dpa, pulsing reduced the amount of radiation-induced G phase. Long pulse periods promoted the thermally-stable MC phase, while shorter periods like 10(-3) s aided M6C and M23C6 development. In helium-implanted material bubbles were present for all pulsing conditions but bias-driven voids only developed in continuously-irradiated specimens. The results are interpreted with regard to the inherent fluctuations in point defect concentrations that result from cascade formation. DOE

N86-26425# Brookhaven National Lab., Upton, N. Y.
APPLICATIONS OF CURRENT MEASUREMENT OVER CORRODING METALLIC SURFACES
H. S. Isaacs 1985 8 p refs Presented at Ionic Currents Conf., Los Angeles, Calif., 2 Aug. 1985
(Contract DE-AC02-76CH-00016)
(DE86-001174; BNL-36993; CONF-8508137-1) Avail: NTIS HC A02/MF A01

The scanning vibrating probe was used to study a number of different corrosion related systems: aluminum and iron pitting, metallic and organic coatings, pitting and crevice corrosion of stainless steels, and stress corrosion cracking. A few examples are presented to illustrate the technique. DOE

N86-26426# Northwestern Univ., Evanston, Ill.
EFFECTS OF QUENCHED-IN HYDROGEN ON DEFORMATION OF IRON SINGLE CRYSTALS
K. Hsashimoto and M. Meshii 1985 4 p Presented at the 7th International Conference on the Strength of Metals and Alloys, Montreal, Quebec, 12 Aug. 1985
(Contract DE-AC02-76ER-01367)
(DE86-001883; DOE/ER-01367/158; CONF-850823; COO-1367-158) Avail: NTIS HC A02/MF A01

Effects of hydrogen on mechanical properties were investigated in iron single crystals quenched from temperatures between 833 and 1133 K in a hydrogen atmosphere. The specimens were tensile-tested in a temperature range from 77 to 200 K. The specimens quenched from 1133 K deformed almost exclusively by twinning and fractured at 77 K, the reference specimens cooled slowly from 1133 K deformed plastically without twinning and failed in a ductile manner. The twinning stress was lower that the yield stress of the reference specimens. Aging at room temperature completely eliminated the effect of hydrogen-quenching, indicating that hydrogen dissolved in iron is responsible for twinning. The specimens oriented to the [110] tensile direction deformed substantially even if they were quenched from 1133 K in a hydrogen atmosphere. The flow stress of the hydrogen-quenched specimens was lower than that of the reference specimens in the temperature range from 77 to 200 K. This softening effect was smallest at 200 K. DOE

N86-26427# Arizona State Univ., Tempe. Dept. of Mechanical and Aerospace Engineering.
ROLE OF HYDROGEN, SULFUR AND OTHER IMPURITIES IN INTERGRANULAR FRACTURE IN IRON
K. S. Shin and M. Meshii 1985 4 p Presented at the 7th International Conference on the Strength of Metals and Alloys, Montreal, Quebec, 12 Aug. 1985
(Contract DE-AC02-76ER-01367)
(DE86-001884; DOE/ER-01367/157; CONF-850823; COO-1367-157) Avail: NTIS HC A02/MF A01

The intergranular fracture stress was investigated as a function of grain boundary concentrations of sulfur and/or H in polycrystalline MRC-VP iron specimens. The fracture energy was determined as a function of grain boundary sulfur concentration by analyzing the empirical relations with a modified Griffith equation. Two different effects of H, permanent and reversible, were identified. The permanent effect of H was caused by the formation of intergranular microcracks due to the precipitation of supersaturated H and recovered only partially after annealing at high temperatures. The size of microcracks was found to be proportional to the square of H concentration at grain boundaries. The predicted sizes of the microcracks agreed well with those determined metallographically. The present study clearly indicates that there is no synergistic effect between H and sulfur on intergranular fracture of iron regardless of whether the H effect is reversible or permanent. It was found that the primary effect of C is to displace sulfur from grain boundaries and thus to improve the grain boundary strength by reducing the embrittling effect of sulfur. The second effect of C is to increase the frictional stress to dislocation motion and thus to increase the apparent stress for intergranular fracture. DOE

N86-26428# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Material- und Festkoerperforschung.
COMPARISON OF HIGH TEMPERATURE STEAM OXIDATION BEHAVIOR OF ZIRCALOY-4 VERSUS AUSTENITIC AND FERRITIC STEELS UNDER LIGHT WATER REACTOR SAFETY

ASPECTS
S. Leistikow, G. Schanz, and Z. Zurek (Technical Univ. of Cracow, Poland) Dec. 1985 38 p Presented at Polish-German Seminar on Properties of High Temperature Alloys, Kracow, Poland, 3-6 Jul. 1983
(KfK-3994; ISSN-0303-4003; ESA-86-96912) Avail: NTIS HC A03/MF A01

The oxidation behavior of Zircaloy-4, ferritic-martensitic steel 1.4914, and austenitic stainless steel 1.4970 was compared. Nuclear reactor typical tube sections were exposed on both sides to superheated steam at temperatures from 600 to 1300 C for up to 6 hr. Corrosion resistance of Zircaloy-4 is between austenitic and ferritic steel. Because of the chosen wall dimensions, Zircaloy-4 and the austenitic steel behave similarly in that the faster oxidation of the thicker Zircaloy-4 cladding consumes the total wall thickness in a time equivalent to the slower oxidation of the thinner austenitic steel cladding. The ferritic steel cladding is consumed faster because of the lower oxidation resistance and the thinner wall thickness compared to the austenitic steel. Besides oxide scale formation, oxygen diffusion into the bulk of the metal, forming oxygen-containing phases was evaluated. Their influence on mechanical cladding properties and dimensional changes were studied. ESA

N86-26429# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
ENGINEERING PROPERTY COMPARISONS FOR 2324-T39 AND 2024-T351 ALUMINUM ALLOY PLATE
L. Schra and W. G. J. tHart 19 Mar. 1984 64 p
(Contracts NIVR-1906)
(NLR-TR-84021-U; B8576225; ESA-86-96979) Avail: NTIS HC A04/MF A01

Engineering properties of the plate material of aluminum alloy 2324-T39 and alloy 2024-T351 were compared. Tensile strength, fracture toughness, notched fatigue strength, and the resistance to fatigue crack propagation under constant amplitude and flight simulation loading were considered. Significantly higher strength and fracture toughness properties are found for 2324-T39, but the notched fatigue strengths of both alloys are comparable. Fatigue crack propagation resistance of 2324-T39 is slightly better than 2024-T351 under constant amplitude loading, but less resistant under flight simulation loading. The latter result indicates that replacement of 2024-T351 by 2324-T39 in fatigue critical areas is questionable. ESA

N86-26430# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
EFFECTS OF CLADDING AND ANODIZING ON FLIGHT SIMULATION FATIGUE OF 2024-T3 AND 7475-T761 ALUMINUM ALLOYS
R. J. H. Wanhill Jan. 1985 29 p refs
(Contracts NIVR-1891)
(NLR-TR-85006-U; B8578427; ESA-86-96984) Avail: NTIS HC A03/MF A01

The effects of cladding and anodizing on flight simulation (gust spectrum) fatigue of notch specimens and riveted lap joints of 2024-T3 and 7475-T761 aluminum alloy sheet were investigated. Stress levels were chosen to provide long life data (100,000 simulated flights) for bare alloy specimens. Cladding and anodizing have very large effects on the fatigue lives. Cladding and anodizing are always detrimental for notched specimens. For lap joints, cladding is detrimental only combined with anodizing. Anodizing is very beneficial for lap joints to be assembled from bare alloy sheets. With equivalent surface treatments 2024-T3 specimens always have longer average fatigue lives than 7475-T761 specimens. ESA

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N86-26431# Kirk-Mayer, Inc., Albuquerque, N. Mex.
INFLUENCE OF DEPOSITION VARIABLES ON LPCVD TUNGSTEN FILMS DEPOSITED BY THE WF6/SI REDUCTION
M. E. Tracy 1985 16 p Presented at Workshop
(Contract DE-AC04-76DP-00789)
(DE86-003727; SAND-85-7254C; CONF-8510238-1) Avail: NTIS HC A02/MF A01

In an effort to isolate and study the Si reduction of WF6 by the reduction reaction 2 WF6 + 3 Si (YIELDS) 2 W + 3 SiF4, a systematic study of the influence of temperature, substrate doping, deposition time and variable flow rates of tungsten hexafluoride (WF6) was conducted. The effect of varying these parameters on film thickness, layer resistivity, encroachment and adhesion was investigated. A set of operating conditions has been defined that yield stable, adherent, self-limiting films of -100A thickness that are free from encroachment. Film quality was found to be relatively insensitive to moderate variations in process parameters, a favorable indication in terms of process integration and manufacturability. DOE

N86-26432# Oak Ridge National Lab., Tenn.
HARDNESS OF ION IMPLANTED CERAMICS
W. C. Oliver, C. J. McHargue, G. C. Farlow, and C. W. White 1985 11 p Presented at the Materials Research Society Meeting Prepared in cooperation with Wright State Univ., Dayton, Ohio
(Contract DE-AC05-84OR-21400)
(DE86-004771; CONF-851217-21) Avail: NTIS HC A02/MF A01

It has been established that the wear behavior of ceramic materials can be modified through ion implantation. Studies have been done to characterize the effect of implantation on the structure and composition of ceramic surfaces. To understand how these changes affect the wear properties of the ceramic, other mechanical properties must be measured. To accomplish this, a commercially available ultra low load hardness tester has been used to characterize Al2O3 with different implanted species and doses. The hardness of the base material is compared with the highly damaged crystalline state as well as the amorphous material. DOE

N86-26433# Sandia National Labs., Albuquerque, N. Mex.
FORMATION OF SURFACE LAYERS OF ICOSAHEDRAL Al(Mn)
J. A. Knapp and D. M. Follstaedt 1985 22 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985
(Contract DE-AC04-76DP-00789)
(DE86-004606; SAND-85-1335C; CONF-851217-19) Avail: NTIS HC A02/MF A01

Surface layers of the icosahedral phase of Al(Mn) have been formed from thin, alternating Al/Mn layers deposited on Al or Fe surfaces by rapid electron-beam or laser melting, by ion beam mixing, and by solid-state diffusion. The electron beam and laser treatments are similar to other liquid quenching techniques used previously to form the phase, but have well defined temperature histories which place limits on the melting point of the icosahedral phase, the time needed to its nucleation from the melt, and its growth velocity. Ion beam mixing is a way of forming the icosahedral phase which is quite different from melt quenching; the phase is formed during ion beam mixing at temperatures of 100 to 200 C. For mixing at less than or equal to 60 C an amorphous phase with icosahedral short-range order is formed, and this phase can be converted to the icosahedral phase by subsequent annealing. Formation of the icosahedral phase by reacting the as-deposited layers in the solid state has not been reported elsewhere. The results presented here place new restrictions on proposed structural and thermodynamic models for the icosahedral phase. DOE

N86-26434*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

OXIDATION PROTECTING COATINGS FOR POLYMERS Patent Application
James S. Sovey, inventor (to NASA), Bruce A. Banks, inventor (to NASA), and Michael J. Mirtich, inventor (to NASA) Filed 27 Feb. 1986 12 p Sponsored by NASA
(NASA-Case-LEW-14072-3; NAS 1.71:LEW-14072-3; US-Patent-APPL-SN-834977) Avail: NTIS HC A02/MF A01 CSCL 11B

A polymeric substrate is coated with a metal oxide film to provide oxidation protection in low Earth orbital environments. The film contains about four volume percent polymer to provide flexibility. NASA

N86-26435*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
POLYETHER-POLYESTER GRAFT COPOLYMER Patent Application
Vernon L. Bell, inventor (to NASA) Filed 24 Apr. 1986 20 p Sponsored by NASA
(NASA-Case-LAR-13447-1; NAS 1.71:LAR-13447-1; US-Patent-Appl-SN-855879) Avail: NTIS HC A02/MF A01 CSCL 11B

This invention relates to a polyether graft copolymer having improved solvent resistance and crystalline thermally reversible crosslinks. The copolymer is prepared by a novel process of anionic copolymerization. The polymers of this invention exhibit good solvent resistance and are well suited for commercial aircraft parts. Previous aromatic polyethers, also well known as polyphenylene oxides, have certain deficiencies which detract from their usefulness. These well known commercial polymers are often soluble in common solvents including the halocarbon and aromatic hydrocarbon types of paint thinners and removers. This limitation prevents the use of these polyethers in structural articles that require frequent painting. In addition, the most popular commercially available polyether is a very high melting plastic. This makes it considerably more difficult to fabricate finished parts from this material. The present invention solves these problems by providing an aromatic polyether graft copolymer with improved solvent resistance and crystalline thermally reversible crosslinks. The graft copolymer is formed by converting the carboxyl groups of a carboxylated polyphenylene oxide polymer to ionic carbonyl groups in a suitable solvent, reacting pivalolactone with the dissolved polymer, and adding acid to the solution to produce the graft copolymer. NASA

N86-26436# Department of the Air Force, Washington, D.C.
PAINT REMOVAL PROCESS Patent Application
Roberts, inventor (to Air Force) Filed 18 Dec. 1985 13 p
(AD-D012167; US-Patent-Appl-SN-810140) Avail: NTIS HC A02/MF A01 CSCL 11/11

A process of stripping paint from aluminum employs plastic particulate having sharp edges, having a hardness of about 3.5 on the mohs' scale and having a range of sizes from about 30 to 40 u.s. standard sieve. This media strips aluminum without abrasion at a pressure of about 25 to 40 pounds per square inch at the nozzle. Other substrates other than soft plastic can be stripped without damage. GRA

N86-26437# Department of the Air Force, Washington, D.C.
ETHYNYL-CONTAINING AROMATIC POLYAMIDE RESINS Patent Application
Robert C. Evers, inventor (to Air Force) 10 Dec. 1985 26 p
(AD-D012169; US-Patent-Appl-SN-807426) Avail: NTIS HC A03/MF A01 CSCL 11/9

In accordance with the present invention there is provided a novel aromatic polyamide resin having repeating units, each containing at least one o-ethynyl amido subunits. The resins of this invention which contain the above subunit can be thermally treated to undergo intramolecular cyclization, without evolution of volatiles, into polyimidines. GRA

N86-26438# Department of the Air Force, Washington, D.C.
ETHYNYL-CONTAINING AROMATIC MONOMERS Patent Application
Robert C. Evers, inventor (to Air Force) Filed 10 Dec. 1985 26 p
(AD-D012170; US-Patent-Appl-SN-807155) Avail: NTIS HC A03/MF A01 CSCL 11/9

In accordance with the present invention there are provided novel aromatic monomers, each containing at least one o-ethynyl carboxylic acid halide subunit. The monomers of this invention which contain the above subunit can be reacted with amines to form aromatic polyamide resins which can be thermally treated to undergo intramolecular cyclization, without evolution of volatiles, into polyimidines. The first of the monomers of this invention is tolane-2,4'-dicarbonyl halide. The second of the monomers of this invention is a 2,5-bis (arylethynyl) terephthaloyl halide. GRA

N86-26439# Detroit Univ., Mich. Polymer Inst.
ENERGY ABSORPTION OF POLYURETHANE-BASED POLYMER ALLOYS Interim Technical Report, 1 Jul. - 31 Dec. 1985
Bijan Sedghi, Kachorn Wongkamolsesh, Daniel Klempner, and Kurt C. Frisch 31 Jan. 1986 48 p refs
(Contract DAAG29-85-K-0129)
(AD-A164537; ARO-22361.1-MS) Avail: NTIS HC A03/MF A01 CSCL 11/9

Interpenetrating polymer networks (IPNs), elastomers, and foams composed of polyurethanes and epoxies were prepared by the simultaneous technique. The effect of platelet geometry fillers (e.g., graphite, mica, glass) and cure time on the morphology of the IPNs was investigated. Fillers were incorporated by random batch mixing and the rubber roll mill technique. It was determined that low level of filler resulted in a small increase of dynamic mechanical properties (tan delta) and as the filler level increased, tan delta decreased. Samples with low post-curing times showed higher magnitudes of tan delta than samples with longer post-curing time. IPN foams with different ratios of polyurethane and epoxy were prepared at their sound absorption properties were measured by the impudance tube method. Different PU/Epoxy ratios showed different maximum sound absorption frequency ranges. In general, the IPN foams prepared showed higher sound absorption properties than the GM polyurethane foam reference. GRA

N86-26440# Massachusetts Univ., Amherst. Polymer Research Inst.
DYNAMIC ORIENTATION STUDIES OF POLYMERS Final Report, 1 Oct. 1981 - 30 Sep. 1984
Richard S. Stein 3 Feb. 1986 8 p refs
(Contract DAAG29-82-K-0010)
(AD-A164611; ARO-18537.1-CH) Avail: NTIS HC A02/MF A01 CSCL 20/6

Static and dynamic X-ray diffraction, small angle X-ray scattering, small angle light scattering, birefringence, and infrared dichroism studies have been carried out on crystalline polymers (mostly polyethylenes) and their blends. Preliminary small angle neutron scattering studies of their orientation have been made. GRA

N86-26441# National Bureau of Standards, Gaithersburg, Md.
STUDY OF CHARGE AND POLARIZATION DISTRIBUTION IN POLYMERS Final Report, 1 Jul. 1982 - 30 Jun. 1985
Aime S. DeReggi 21 Jan. 1986 11 p refs
(Contracts MIPR-ARO-58-82; MIPR-ARO-143-83)
(AD-A164633; ARO-18712.5-PH) Avail: NTIS HC A02/MF A01 CSCL 20/3

It has been established that space charge effects are important in determining the polarization distribution of ferroelectric polymers when these are poled under conditions of significant, though still extremely small, conductivity. Asymmetric distributions are observed and these are indicative not only of space charge present during poling but also of polarity-dependent barrier effects at the metallic electrode-polymer interfaces. Among the polymers surveyed, which gave simple asymmetric polarization profiles, PVF2 and P(VF2-TE) showed a tendency to pole most strongly in the regions near the poling anode indicating accumulation of negative charge during poling, while PVF and Nulon 11 tend to pole most

strongly near the poling cathode, indicating accumulation of positive charge. The difference among samples in the sign of the change accumulated during poling suggests that a basic relation exists between charging behavior and bulk or surface polymer structure; however, additional work is required to establish the nature of such a relation. Under conditions of negligible conductivity, the observation of nonuniform sample properties are suspected to be of morphological origin or due to pre-existing polarization of unknown origin. However, it appears that under these conditions, the polarization distributions are nominally symmetric. Studies of electron-beam irradiated PVC have revealed interesting, new information-storage properties of this material. GRA

N86-26442# Rutgers - The State Univ., Piscataway, N. J. Dept. of Mechanics and Materials Science.
FIELD-INDUCED CRYSTALLIZATION IN HIGHLY PLASTICIZED POLY(VINYLIDENE FLUORIDE) FILMS
J. I. Scheinbeim, B. A. Newman, and A. Sen 27 Jan. 1986 30 p refs
(Contract N00014-80-C-0795)
(AD-A164684; TR-7) Avail: NTIS HC A03/MF A01 CSCL 20/3

Highly plasticized films of poly(vinylidene fluoride) (PCF2) containing approximately 18% by weight of tricresyl phosphate (TCP) and with initial crystallinites (phase II) of approximately 15% were poled under high vacuum. The poling temperatures were 75 C and 90 C and the poling field was 250 KV/cm. The poling time was varied from 15 minutes to 240 minutes. Weight measurements and X-ray diffraction data of poled films showed that with increasing poling time, (up to 4 hrs) that plasticizer content decreased (to a minimum of 11%) and the crystallinity of the PVF2 films increased (to a maximum of 45%). The field induced crystallization occurred as highly oriented phase I crystals. After poling for 1 hour (at 90 C), a significant percent of the crystalline material was observed to be in the polar phase I form. At longer times, a measure of the relative percent of phase I with respect to the total crystallinity decreased. As expected, the piezoelectric strain coefficient d sub 31, stress coefficient e sub 31, and pyroelectric coefficient P sub y increased with increasing phase I content, reaching maximum values after a 1 hour poling time at 90 C of d sub 31 approx. = 10 PC/N, e sub 31 approx. = 11 mc/m2 and P sub y approx. = 17 micro Cm per deg K. The dynamic mechanical modulus and d ielectric constant (measured at 3 Hz) were found to be approx. 1.3 GN/sq m and approx. 14.7 respectively under these poling conditions. GRA

N86-26443# Naval Civil Engineering Lab., Port Hueneme, Calif.
THE EFFECTS OF STEEL PROFILE AND CLEANLINESS ON COATING PERFORMANCE Technical Note, Oct. 1979 - Sep. 1984
Richard W. Drisko, Eddy S. Matsui, and Lee K. Schwab Jan. 1986 33 p
(AD-A164788; NCEL-TN-1741) Avail: NTIS HC A03/MF A01 CSCL 11/3

A 5-year study was conducted in cooperation with the Steel Structure Painting Council (SSPC) to determine surface profile and cleanliness requirements for long-term performance of generic coating systems currently used on Navy shore facilities. The experimental design included two levels of cleaning (white metal finish and commercial finish), four levels of profile height (low, medium, high, and very high), eight levels of abrasive (eight different abrasives), and six levels of generic coating system (alkyd, acrylic latex, vinyl, epoxy, coal tar epoxy, and inorganic zinc/vinyl). Replicate sets of the different variations were exposed in a salt fog chamber and at test exposure sites in a tropical marine atmospheric environment at Kwajalein Atoll in the Marshall Islands; in an industrial environment at Pittsburgh, Pa.; and in a relatively mild marine atmospheric environment at Kure Beach, N.C. After 15 months of exposure at Kwajalein, relatively little change had occurred in the overall loss in bonding strength. Significantly different variations occurred between the different coating systems, and the range of values was greatly reduced. Salt fog exposure had a much greater effect on loss of adhesion than did natural exposure for 57 months for the periods measured. Levels of statistical significance for performance at Kwajalein varied greatly with time and were much greater on scribed than unscribed specimens. Author (GRA)

N86-26444# Naval Civil Engineering Lab., Port Hueneme, Calif.
EXPERIMENTAL POLYURETHANE FOAM (PUF) ROOFING SYSTEMS. 3. NAVAL STATION, ROOSEVELT ROADS, PUERTO RICO, AND NAVAL FACILITY, CAPE HATTERAS, NORTH CAROLINA Interim Report, Sep. 1978 - Mar. 1984
Spencer R. Conklin, Daniel A. Zarate, and Robert L. Alumbaugh Jan. 1986 61 p
(AD-A164833; NCEL-TN-1742) Avail: NTIS HC A04/MF A01 CSCL 11/9

This report presents information on field investigations of experimental polyurethane foam (PUF) roofing systems installed at the Naval Station, Roosevelt Roads, P.R., and the Naval Facility, Cape Hatteras, N.C. The roof systems at Roosevelt Roads included three different foams applied at two thicknesses, five protective coating systems applied at thicknesses recommended by their manufacturer, and two different mineral roofing granules applied in the wet topcoat. The majority of the housing units was coated with acrylic and silicone coating systems, but urethane/hypalon, modified urethane, and butyl/hypalon elastomeric coating systems were also used. The roofing system installed on the Galley at Cape Hatteras was acrylic elastomer coated PUF roof applied over a modified bitumen membrane. At Roosevelt Roads, the butyl/hypalon coated system weathered the best. Energy consumption at Roosevelt Roads decreased at most only 12 to 13% after foaming the roofs. Mineral roofing granules improved weathering characteristics for the acrylic systems but not the silicones. At Cape Hatteras, one-half of the acrylic-coated roof weathered very well, while the other half showed extensive blistering. GRA

N86-26445# Naval Research Lab., Washington, D. C.
BIODEUTERATED MATERIALS: HIGH-TEMPERATURE LUBRICANTS FROM ALGAE Interim Report, Oct. 1984 - Sep. 1985
Rex A. Neihof, Mark M. Ross, and Joseph E. Campana 6 Jan. 1986 21 p refs
(AD-A164913; NRL-R-8952) Avail: NTIS HC A02/MF A01 CSCL 11/8

Substitution of deuterium for hydrogen imparts an enhanced resistance to oxidation in materials such as lubricants. The exploitation of this and other novel properties of deuterated materials in applications of Naval interest is only beginning to be realized. As an alternative to the conventional chemical methods of synthesizing deuterated compounds employing high temperature and reducing conditions, the present work explores the possible advantages of using algae grown in deuterium oxide (D2O) to provide completely deuterated precursors that are suitable for synthesizing a variety of lubricants. By proper choice of organism and growth conditions, it was possible to obtain dense cultures of algae containing 50 to 60% of their dry weight as long-chain fatty acids with different degrees of unsaturation. This report outlines strategies for synthesizing lubricant materials from these fatty acids and discusses the extension of biosynthesis to other deuterated materials such as polymers. GRA

N86-26446# Southwest Research Inst., San Antonio, Tex. Fuels and Lubricants Research Facility.
HIGH-TEMPERATURE LUBRICATION SYSTEMS FOR RING/LINER APPLICATIONS IN ADVANCED HEAT ENGINES Interim Report, Oct. 1984 - Jul. 1985
M. D. Kanakia, E. C. Owens, and M. B. Peterson Jul. 1985 66 p Prepared in cooperation with Wear Sciences, Inc., Arnold, Md.
(Contracts DAAK70-82-C-0001; DAAK70-85-C-0007)
(AD-A164955; BFLRF-189) Avail: NTIS HC A04/MF A01 CSCL 11/8

An assessment of tribological requirements in upper cylinder area of advanced high temperature engines was made in terms of critical components and their operating conditions. The ring-liner applications are the most severe since they have high temperature (<800 F) and large number of sliding cycles 10 to the 8th power - 10 to the 10th power. This report explores and evaluates various

high temperature tribological systems lubricants, materials and lubricant delivery or supply systems for high temperature ring-liner applications. Author (GRA)

N86-26447# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
STRUCTURE/PROPERTY STUDIES OF A HETEROCYCLIC CONDUCTIVE POLYMER Final Report
Leonard J. Buckley 1 Nov. 1985 39 p
(AD-A164959; NADC-85160-60) Avail: NTIS HC A03/MF A01 CSCL 07/4

Oxidized conductive polypyrrole/anion materials have been electrochemically synthesized under various preparation conditions to study the influence of electrode potential, current density, and anion species on the composition, structure, and properties. Elemental analysis indicates an increase in the sulfur/nitrogen ratio as the electrode potential is increased for polypyrrole/tosylate (PP(+)/OTs(-)). This implies an increase in anion concentration (or extent of oxidation of polypyrrole chains) with potential. Tensile properties of PP(+)/OTs(-) films have been measured and indicate a strong dependence on synthesis potential and current density. The ultimate tensile strength was found to decrease with an increase in these parameters. The effect of the size of the dopant anion has also been addressed by incorporating various para-substituted benzene sulfonates as the electrolyte counterion in the reaction. Tensile strength, modulus, and strain behavior was examined and has shown a transition in the tensile storage modulus (E') at approximately 25 C. This transition was not dependent on anion species. GRA

N86-26448# Army Construction Engineering Research Lab., Champaign, Ill.
DEVELOPMENT OF A PORTABLE TEST KIT FOR FIELD-SCREENING PAINTS Final Report
Alfred D. Beitelman, Stanley M. Kanarowski, and Peter J. Hearst Jan. 1986 60 p refs
(AD-A164989; CERL-TR-M-86/06) Avail: NTIS HC A04/MF A01 CSCL 11/3

Facility engineers currently have no easy way of establishing if a paint coating is of suitable quality for satisfactory application and performance. As a result, most of the paint used is not tested for specification compliance, which can lead to premature coating failure. This research was undertaken to develop a simple, portable test kit that field personnel can use to check the basic qualities of oil-based and latex paints. The kit enables 14 properties such as drying time, hiding power, appearance, gloss, adhesion, and cleanability to be tested in the field. It is to be used as an initial screening device, so that only paints which do not appear to be equal to a standard need to be sent to a laboratory for more sophisticated testing. The kit's ease of use should encourage more testing prior to application, as well as avoiding the time and expense required for laboratory testing. Development of the kit is described, and instructions for its use are provided. GRA

N86-26449# Cincinnati Univ., Ohio. Dept. of Materials Science and Engineering.
STRUCTURE AND PROPERTIES OF POLYMERS AND ORGANOSILANES ADSORBED ONTO OXIDIZED ALUMINUM AND TITANIUM Final Report, 1 Jul. 1980 - 30 Sep. 1985
F. J. Boerio 31 Jan. 1986 43 p
(Contract N00014-80-C-0733)
(AD-A165210) Avail: NTIS HC A03/MF A01 CSCL 11/1

Wettability envelopes were constructed for mechanically polished iron, titanium, and aluminum from contact angles measured for selected liquids. The results indicated that typical epoxy adhesives should wet all three substrates. The failure path of iron/epoxy and titanium/epoxy lap joints exposed to water at 60 C for varying times was determined using x-ray photoelectron spectroscopy (XPS). When iron/epoxy lap joints were prepared from adherends pretreated with aqueous solutions of Gamma-aminopropyltriethoxysilane (Gamma-APS) at pH 8.0 and tested without exposure to water, failure was mostly within the primer. Joints prepared from adherends primed with Gamma-APS at pH 10.4 failed partly within the adhesive and partly near the interface. Iron/epoxy lap joints always failed in the primer near the primer/oxide interface when tested after exposure to water for seven days but very little corrosion of the substrates was observed. When titanium/epoxy lap joints were tested without exposure to water, failure was partly within the adhesive and partly near the primer/oxide interface regardless of the pH at which the primer was applied. However, the failure path shifted to near the primer/oxide interface after the joints were immersed in water for seven days. It was concluded that failure of the joints after exposure to water was associated with hydrolysis within the primer. The effect of silane primers on the failure properties of aluminum/epoxy tapered double cantilever beams was also investigated. GRA

N86-26450# METECH, Inc., Elverson, Pa.
APPLICATION OF CONDUCTIVE POLYMER TECHNOLOGY TO THE PRODUCTION OF A NOVEL MULTILAYER CAPACITOR
David Mandelblatt and R. Selwood 14 Jan. 1986 14 p
(Contract N00014-86-C-0008)
(AD-A165212) Avail: NTIS HC A02/MF A01 CSCL 09/1

Multilayer ceramic capacitors, due to their large capacitance, reduced volume and low cost, have become one of the fastest growing technologies in electronic devices. Present technology uses barium titanate as the dielectric which requires the use of precious metal (Pd, Pt, Au) internal electrodes as a result of the high firing temperatures (1300 to 1400C). These precious metals are responsible for 50 to 60% of the total cost of the capacitor and are subject to strategic foreign disruption. It is the goal of this investigation to evaluate the feasibility of using a polymer based dielectric and a polymer thick film metal electrode to build a multilayer capacitor that would eliminate the need for precious metals. Once this is accomplished, the next phase would ultimately involve the replacement of the silver in the polymer thick film electrode with synthetic metals. The work involved an extensive literature review, discussions with researchers active in this field and the testing of prototype polymer capacitors. Evaluations were carried out based on capacitance, permittivity dissipation factor and short-term stability. The initial results were considered encouraging and a continuing effort in this direction is most feasible. GRA

N86-26451# Ballistic Research Labs., Aberdeen Proving Ground, Md.
THERMAL RESPONSE TESTS OF CANDIDATE INSULATION SYSTEMS FOR THE CHLORINE TANK CAR Final Report, Dec. 1983 - Aug. 1984
William P. Wright, Wayne A. Slack, and Willis Jackson Feb. 1986 60 p
(AD-A165293; AD-F630715; BRL-TR-2712) Avail: NTIS HC A04/MF A01 CSCL 13/6

A number of thermal tests were performed on three insulation systems. The purpose was to ascertain if an insulation system consisting of existing materials could prevent the temperature of the shell of a chlorine tank car from exceeding 252 C (493 F) while the tank car is exposed to representative fire environments which can occur in a railroad accident. The significance of the temperature criteria is that a corrosive reaction between chlorine vapor and steel begins at approximately that temperature. GRA

N86-26452# Massachusetts Univ., Amherst. Dept. of Polymer Science and Engineering.
ACID-CATALYZED DEGRADATION OF POLY(2-BUTYL-1,3,6-TRIOXOCANE)
James C. W. Chien, C. P. Lillya, and Bao-Bei Xu 10 Jan. 1986 33 p
(Contract N00014-83-K-0083)
(AD-A165327; TR-13) Avail: NTIS HC A03/MF A01 CSCL 07/3

Polyacetals, owing to the acid sensitivity of the acetal linkage, are attractive candidates for end uses in which acid sensitivity is a desirable property, e.g., photo- or electron-resists. Acid catalyzed degradation of poly (2-butyl-1,3,6-trioxocane) (1) has been studied. With ethyl tosylate as the catalyst, the cyclic monomer 2 was the

major product. The minor products are cis and trans isomers of C3H7CH=CH-OCH2CH2OCH2CH2OH, and three stereoisomers of C3H7CH=CH-OCH2CH2OCH2CH2O-CH=CH-C3H7 elucidated by 1H and 13C NMR, IR, electron impact and chemical ionization MS, and in the case of 2 also by comparison with an authentic sample. With 98% H2SO4 as the catalyst 2 is only a minor product. The major products are diethylene glycol, valeraldehyde, and 1,4-dioxane with some 2-butyl-1,3-dioxolane. Capillary GC/Mass spectrometry led to identification of the following less abundant products: tri-n-propylbenzene, alpha, beta-unsaturated aldehydes and cyclic dimer. The products of H2SO4-catalyzed decomposition of polymer were also obtained by heating monomer 2 with H2SO4. A detailed mechanism for the formation of the 8-member ring 2 in the decomposition is proposed which involves unzipping proceeds via open carbocation intermediates. According to the principle of microscopic reversibility, the same open carbocation is the propagating species in the polymerization of 2 under similar conditions. GRA

N86-26453# Vermont Univ., Burlington. Dept. of Chemistry.
ORGANOFUNCTIONAL PHOSPHAZENES AND ORGANOFUNCTIONAL PHOSPHAZENE POLYMERS Final Report
Christopher W. Allen 19 Feb. 1986 4 p refs
(Contract N00014-77-C-0605)
(AD-A165437; AD-F250510; TR-17) Avail: NTIS HC A02/MF A01 CSCL 07/3

The report provides a brief outline of the approaches used to build traditional polymers with cyclophosphazene moieties as substituents. The physical and chemical properties, including flame retardancy, of these materials are noted. GRA

N86-26454# Stanford Univ., Calif. Petroleum Research Inst.
APPARENT VISCOSITY MEASUREMENTS OF SURFACTANT FOAM IN POROUS MEDIA
R. J. Treiner, W. E. Brigham, and L. M. Castanier Dec. 1985 37 p
(Contract DE-AC03-81SF-11564)
(DE86-000260; DOE/SF-11564/13; SU-SUPRI-TR-48) Avail: NTIS HC A03/MF A01

The apparent viscosity of surfactant foam in a sand pack model was measured at reservoir flow velocities. The effects of foam quality, surfactant concentration, and flow rate were investigated. Ottawa sand, 120 to 140-mesh, was packed into a 1 by 24 inch tube. Porosity was 38%, and permeability ranged from 5 to 8 darcies. Foam of a known quality and flow rate was continuously injected into the sand pack until a steady state condition was reached. Pressure drop was measured across three different segments of the sand pack. A system back pressure of 50 psig was applied to minimize changing foam quality caused by gas expansion. The surfactant used in this study was Suntech IV. All measurements were made at room temperature. Results show that the apparent viscosity of surfactant foam ranges from 50 to 70 centipoise at reservoir flow velocities. Increasing the foam quality corresponded to a small increase in the apparent viscosity of foam. Changes in surfactant concentration from 0.005 to 0.05 wt % caused a rapid increase in apparent viscosity. Changes in concentration above 0.05 wt % had little effect on apparent viscosity. Increasing the flow rate resulted in a reduction of the apparent viscosity of foam. This pseudo-plastic flow behavior has been widely reported in the literature. The apparent viscosity of foam in porous media was significantly effected by flow rate history. DOE

N86-26455# Brandeis Univ., Waltham, Mass.
SYNTHESIS AND PROPERTIES OF NOVEL ELECTROACTIVE ORGANOMETALLIC POLYMERS Annual Progress Report, Mar. 7 - 1 Dec. 1985
M. Rosenblum 18 Dec. 1985 6 p
(Contract DE-FG02-85ER-45193)
(DE86-004951; DOE/ER-45193/T1) Avail: NTIS HC A02/MF A01

This report describes the synthesis and crystal structure of 1.8-diruthenocenylnaphthalene and the preparation of the first oligomers based on this system. DOE

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N86-26456# Mueller Associates, Inc., Baltimore, Md.
ADVANCED PROPULSION SYSTEMS AND ALTERNATIVE FUELS FOR NON-HIGHWAY TRANSPORTATION. AN ASSESSMENT OF UNIQUE AND PRIORITY RESEARCH AND DEVELOPMENT OPPORTUNITIES. VOLUME 3. A COMPENDIUM OF RESEARCH AND DEVELOPMENT Final Report
Sep. 1985 166 p
(Contract DE-AC01-84ER-30063)
(DE86-002975; DOE/ER-30063/T3-Vol-3) Avail: NTIS HC A08/MF A01

This report documents the combined results of a literature search and personal communications activity designed to identify on-going R and D and suggested R and D needs for advanced propulsion systems and alternative fuels utilization technologies for non-highway transportation applications. The results are presented in the three subsequent chapters of this report. Section 3 presents the results of the literature search. Some of the information reported in Section 3 was obtained through communications with and information received from various government and private R and D funding entities. Each identified R and D program or project is summarized and various additional information deemed pertinent is noted. Section 4 presents the results of discussions and communications with various private organizations and academic institutions. These discussions and communications were designed to buttress the literature search effort and were conducted independently of the literature search. Thus, some cross-reporting of research efforts will exist. Section 5 presents the results of personal communications with selected key researchers. This latter activity was designed to elicit recommendations of R and D needs, thus providing the workshop panel with additional advance information for its considerations as well as to provide additional input for the final assessments reported in Volume 1. DOE

N86-26457# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
TNT RDX AND HMX EXPLOSIVES IN SOILS AND SEDIMENTS. ANALYSIS TECHNIQUES AND DRYING LOSSES
J. H. Cragin, D. C. Leggett, B. T. Foley, and P. W. Schumacher Oct. 1985 18 p
(AD-A163278; CRREL-85-15; AMXTH-TE-TR-85038) Avail: NTIS HC A02/MF A01 CSCL 13/2

A method for the analysis of TNT, RDX and HMX explosives in soils and sediments has been developed. It consists of methanol extraction followed by reversed-phase high performance liquid chromatography using 10% acetonitrile/40% methanol/50% water as the eluant. This method was used to study the effect of various drying techniques on the recovery of TNT, RDX, and HMX from soil and sediment samples contaminated with high (%) and low (micron g/g) levels of these explosives. For highly contaminated samples, complete recovery of TNT and RDX was obtained using freeze drying while air drying at room temperature resulted in greater than 90% recovery for both explosives. Other techniques, such as oven drying at 105 C, oven drying at 45 C, microwave oven drying, and drying under infrared lamps, all resulted in greater losses, with TNT and RDX recoveries ranging from 76 to 90%. Drying losses were not due to simple volatilization containing low levels of TNT, RDX and HMX. Recoveries of all three explosives were quantitative for all the above drying techniques.

Author (GRA)

N86-26458# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATIONS OF BURNING SURFACES OF PROPELLANT GRAIN WITH EMBEDDED METAL WIRES AND OF INTERNAL BALLISTICS OF SUCH MOTOR
H. Hongquing 19 Dec. 1985 18 p
(AD-A163361; FTD-ID(RS)T-0904-85) Avail: NTIS HC A02/MF A01 CSCL 21/9

The propellant grain with embedded metal wires capable of producing two-stage thrusts, which suffers complex surface changes during the combustion process, is analyzed. Seven pertinent items of this grain are summarized which are very useful for the studies of its complex burning surfaces and the derivation of its calculation formulas about the burning surfaces. The calculation formulas of burning surfaces and that of internal ballistics are combined to form a chain of control equations. With this control chain, the burning processes of different stage and phase can be predicted very accurately if a double iteration method which satisfies optimum control conditions is used. The entire calculation process is a very good simulation of combustion, and the calculated results are in good agreement with the experimental data. GRA

N86-26459# Defence Research Establishment Suffield, Ralston (Alberta).
THE EFFECT OF AIR GAPS ON THE PROPAGATION OF DETONATION IN CHARGES CONSISTING OF STACKED BLOCKS OF CAST TNT
A. W. Gibb Dec. 1985 89 p
(AD-A163398; AD-E500738; DRES-385) Avail: NTIS HC A05/MF A01 CSCL 19/1

A series of experiments was conducted to examine the influence on the uniformity of detonation propagation of air gaps between large blocks of slow-cooled cast TNT. Donor-receptor geometries examined were: (1) two blocks with the detonation front parallel to the gap edge, and (2) four blocks with one corner in common and the (planar) detonation front at an angle of 45 deg to the block edge. Air gaps from 3 mm to 25 mm were studied. The two-block configurations produced no distortion of the shape, but the measured detonation velocity in the donor blocks and the scatter in results in the receptor blocks were observed to be influenced by the orientation of the propagation velocity vector with respect to the long axis of the TNT crystals. The four-block configuration featured channelling of detonation gases ahead of the front in the air gaps, leading to an initially complex and distorted wave structure, as well as to a delay in reinitiation, in the vertically-opposite receptor block. The shape distortion and delay effects increased as the gap width was increased. GRA

N86-26460# Southwest Research Inst., San Antonio, Tex. Fuels and Lubricant Research Facility.
UNUSUAL CONTAMINANT IN JP-4 FUEL DELIVERED TO FORT CAMPBELL, FORT KNOX, AND TENNESSEE ARMY NATIONAL GUARD Interim Report, Apr. - Jul. 1985
J. G. Barbee, R. S. McInnis, K. B. Kohl, and L. L. Stavinoha Nov. 1985 86 p
(Contract DAAK70-85-C-0007)
(AD-A163399; AD-E500738; BFLRF-201) Avail: NTIS HC A05/MF A01 CSCL 07/4

Many common types of debris were encountered during the course of a recent investigation to identify an unusual contaminant present in jet fuel (JP-4) at three Army locations. Most of the other debris were materials commonly found in fuel samples, e.g., metal flakes, rust, fibers, dirt, etc. Various analytical techniques used in this evaluation indicated that the unusual flake-like organic debris was probably a manmade (synthetic) organic component and not a fuel product. It had a high melting point (> 200 C) and was insoluble in most common solvents. The physical appearance of the flakes (thin and flat while floating in the fluid) indicated that the material was originally formed or deposited in a thin layer prior to its introduction into the fuel. The most likely source of a material with these characteristics was an unpigmented paint or protective coating from one of the epoxy or similar resin families. Such a material could be introduced into the fuel by debonding or delamination of the contaminant from any handling, storage, or transportation equipment that contains such a coating. The elements, chemical bonds, and functional groups detected by the various analytical tests were consistent with this conclusion. The use of a light box for enhanced visual (Clean and Bright) evaluation is presented in this report. GRA

N86-26461# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
CRACK PROPAGATION AND BRANCHING IN BURNING SOLID PROPELLANTS AND IGNITION OF NITRAMINE-BASED COMPOSITE PROPELLANTS Annual Report, Nov. 1984 - Dec. 1985
Kenneth K. Kuo, John A. Moreci, Jong U. Kim, Takaaki Torikai, and Mark Grubelich Jan. 1986 116 p
(Contract N00014-79-C-0762)
(AD-A164630; AR-1) Avail: NTIS HC A06/MF A01 CSCL 21/9

Three major tasks performed during the report period of investigation were: (1) crack propagation and branching in burning solid propellants, (2) ignition of nitramine-based composite propellants under rapid pressurization, and (3) ignition of nitramine-based composite propellants by CO_2 laser. Propellant samples have been recovered by interrupted burning experiments. Four modes of crack propagation and/or branching were observed. The amount of surface area generated by mixed or branched modes is substantially higher than that of the single crack propagation mode, and thus could cause sufficiently severe burning in the damaged zone to result in rocket motor failure. The crack propagation problem is analyzed through the use of basic physical principles, experimental results, and Schaper's theory of crack propagation. A set of governing dimensionless parameters which control and characterize the degree of damage has been obtained. These parameters can be used to develop guidelines for safe operating conditions of rocket motors. Ignition characteristics of a series of RDX-based composite propellants were studied. The times for the onset of light emission (t sub LE) of different propellants under rapid pressurization were compared. It is also found that propellant samples with shorter t sub LE do not necessarily show higher mass consumption, this indicates that propellant vulnerability should be evaluated by both t sub LE and the fraction of mass consumed. GRA

N86-26462# Fluorochem, Inc., Azusa, Calif.
RESEARCH IN ENERGETIC COMPOUNDS Interim Summary Report, 1 Jan. - 31 Dec. 1985
T. G. Archibald, L. C. Garver, M. P. Cohen, and K. Baum Feb. 1986 63 p refs
(Contract N00014-78-C-0147)
(AD-A164901; ONR-2-8) Avail: NTIS HC A04/MF A01 CSCL 07/3

Fluoronitro polymers for use as binders in pyrotechnics applications were investigated. Isopropyl 3,3-difluroroacrylate and 2,2-difluorovinyl isopropyl ketone were synthesized from 3-chloro-3, 3-difluoropropionate and 1-chloro-1,1-difluoro-4-methyl-3-pentanone. Attempted Michael addition reactions of nitronate ions to these olefins failed to give stable adducts. The geminal difluoroazides, 2-azido-2,2-difluoroacetophenone, 1-azido-1,1-difluoro-4-methyl-3-pentanone and isopropyl 3-azido-3,3-difluoropropionate were prepared from the corresponding chlorides with sodium azide. Reaction of lithium 2-nitropropane-1,3-diol acetonide with perfluoroalkyl iodides gave the corresponding 2-perfluoroalkyl-2-nitropropane-1,3-diacetonides. Work was continued on the synthesis of polynitro derivatives of the furofuran ring system. The intermediate furans such as 5-nitro-2-methyl-3-furanmethanol acetate, 3-methyl-2-furanmethanol acetate, and 2,3-furandi-methanol were synthesized, but closure of the second ring has not yet been effected. Work was begun on the synthesis of 1,1,3,3-tetranitrocyclobutane. The model compound 1,1-dinitrocyclobutane was prepared from 1-nitrocyclobutane. Oxidation of 1,3-diaminocyclobutane gave 1,3-dinitrocyclobutane. GRA

N86-26463# Ballistic Research Labs., Aberdeen Proving Ground, Md.
A LUMPED PARAMETER CODE FOR REGENERATIVE LIQUID PROPELLANT GUNS
Terence P. Coffee Dec. 1985 154 p
(AD-A164960; BRL-TR-2703) Avail: NTIS HC A08/MF A01 CSCL 19/6

The governing ordinary differential equations for a lumped parameter model of a regenerative liquid gun are derived. A number of different options and assumptions are implemented. The equations are solved numerically using an efficient and robust computer code. The solutions are compared to a standard code for liquid propellant guns, and the strengths and weaknesses of each method are discussed. GRA

N86-26464# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemistry.
LC-(1)H NMR CHARACTERIZATION STUDIES OF TRICYCLIC AROMATICS AND OLEFINS IN DIESEL FUELS Final Report, Sep. 1982 - 31 Dec. 1985
T. E. Blass, W. R. Bebout, K. A. Caswell, L. Allen, and H. C. Dorn 18 Feb. 1986 55 p
(Contract N00014-82-K-2057; F65-571)
(AD-A165402) Avail: NTIS HC A04/MF A01 CSCL 07/4

New analytical approaches for determination of (1) tricyclic aromatics, (2) alkenes, and weight % data in Naval diesel fuels are described. Tricyclic aromatics are detected and characterized at concentrations as low as approx. 0.25% in diesel fuels. Various analytical approaches for characterizing alkenes in diesel fuels are also explored, including: (1) chromatographic separation of the alkene fraction in diesel fuels by $AgNO_3$ impregnated chromatographic columns, and (2) a 19F NMR tagging method characterizing alkenes. Finally, a calculative method for conversion of LC-1H NMR molar data to weight % data for each chromatographic fraction in a fuel is described. GRA

N86-26465# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Mechanical Engineering.
IMPINGEMENT OF LIQUID FUEL SPRAYS ON HEATED WALLS Final Report, 1 Aug. 1982 - 10 Jul. 1985
Norman Chigier, Francisco Ruiz, and James Zurlo 12 Feb. 1986 81 p
(Contract DAAG29-82-K-0162)
(AD-A165422; ARO-19485.4-EG) Avail: NTIS HC A05/MF A01 CSCL 21/4

An experimental study was made of the structure of high speed Diesel jets. A constant volume chamber was constructed into which sprays of different liquids at a controlled pressure and duration can be injected. The chamber can be pressurized to a design pressure of 900 psi and heated to 750 F. An air operated pump provides liquid injection pressures up to 10,000 psi. Microphotographs of the spray showed the formation of a train of surface waves and the presence of liquid ligaments issuing from the main liquid jet in the radial direction. Discharge coefficients decreased with increasing injection pressure, indicating presence of cavitation in the nozzle. Injection of liquid into a coaxial stream of air with velocities up to 340 m/s allowed determination of the constant A in the aerodynamic theory which represents the intensity of surface perturbations before any amplification by shear occurs. Results of an experiment conducted with liquids of different vapor pressure on 5 nozzles, indicate tha cavitation is a function of a nondimensional pressure parameter. GRA

N86-26466# Mueller Associates, Inc., Baltimore, Md.
ADVANCED PROPULSION SYSTEMS AND ALTERNATIVE FUELS FOR NON-HIGHWAY TRANSPORTATION. VOLUME 1: AN ASSESSMENT OF UNIQUE AND PRIORITY RESEARCH AND DEVELOPMENT OPPORTUNITIES Final Report
Sep. 1985 60 p
(Contract DE-AC01-84ER-30063)
(DE86-002973; DOE/ER-30063/T1-Vol-1) Avail: NTIS HC A04/MF A01

This report is Volume 1 of a three-volume set documenting an assessment of unique and priority research and development opportunities associated with advanced propulsion systems and alternative fuels utilization for non-highway transportation applications. The air, rail, marine, and pipeline modes of transportation were addressed. More specifically, the scope of the study was focused upon advanced fuel-powered prime movers which are or could be applied to aircraft, locomotives, boats/ships, and pipeline pumping/compression station applications. Of note is the fact that advanced electric powered propulsion technologies were not addressed. (This is principally an issue for the rail and pipeline modes.) This report (Volume 1) presents the assessments and recommendations resulting from the study as well as supporting information and background discussions. DOE

N86-26467# Ricardo & Co., Engineers (1927) Ltd., Shoreham-by-Sea (England).
INVESTIGATION INTO ALTERNATIVE FUEL RATING TECHNIQUES Final Report
D. M. Doyle and J. R. Needham Nov. 1985 360 p
(Contract DE-AC01-83CE-50010)
(DE86-004277; DOE/CE-50010/1) Avail: NTIS HC A16/MF A01

An extensive range of fuels have been evaluated in representative naturally aspirated IDI and DI combustion systems with cylinder sizes of 0.61 and 0. 62 liters with rated speeds of 70 and 67 rev/s respectively. Performance, gaseous and particulate emissions and detailed combustion data were obtained, with the objective of correlating combustion and performance parameters with a view towards defining an engine-based fuel rating technique. The ASTM D613 procedure was found to not predict accurately the ignition delay of vegetable oil and volatile blends of naphtha and methanol with D.2. Petroleum and synthetic derived middle-distillates and a vegetable oil ester were ranked correctly. Ignition delay was found to feature mainly in defining cold start, noise and light load HC and CO emissions. A relatively simple rating method measuring ignition delay to rank these parameters, and heat release for NOx ranking, is discussed. Several reasons are given illustrating why an overall rating method will be very complex and perhaps not possible. Recommendations are made to highlight the requirements for improvement in fuel rating methods. DOE

N86-26468# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Propulsion and Energetics Panel.
SMOKELESS PROPELLANTS
Loughton, England Jan. 1986 178 p In ENGLISH and FRENCH Conference held in Florence, Italy, 12-13 Sep. 1985
(AGARD-CP-391; ISBN-92-835-0387-2) Avail: NTIS HC A09/MF A01

Eleven papers are presented from the conference. The specialist meeting was arranged in the following sessions: A review of smokeless propellant technology; Prediction and measurement of signature; Chemistry of smokeless propellants; and Smoke measurements. The purpose of the meeting was to bring together specialized experts in the field of smokeless propellants in order to discuss the definitions of the various degrees of smokelessness, and provide the results of the investigations performed in the last years. The achievements were discussed in the technical evaluation report, which suggests also several subjects for future investigations. For individual titles, see N86-26469 through N86-26479.

N86-26469# Royal Ordnance PLC, Waltham Abbey (England). Research and Development Centre.
SMOKELESS PROPELLANTS OF IMPROVED PERFORMANCE
E. A. Baker *In* AGARD Smokeless Propellants Jan. 1986 p 6-1 - 6-5 (For primary document see N86-26468 17-28)
Avail: NTIS HC A09/MF A01

For double base propellants the high density of nitramines compared with nitrocellulose/nitroglycerine matrices of equivalent energy levels is particularly attractive where propellant energy levels or charge volumes are restrictive. The inclusion of nitramines generally reduced plateau burning rates and impairs plateau quality, but RDX filled extruded propellants with good plateau ballistics and low temperature dependence, suitable for boost applications

were developed. No departure from conventional EDB processing is involved. Author

N86-26470# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
PROPERGOL COMBUSTION BASED ON OCTOGENESIS [COMBUSTION DES PROPERGOLS A BASE D'OCTOGENE]
Guy Longelle and Jean Duterque *In* AGARD Smokeless Propellants Jan. 1986 p 8-1 - 8-17 In FRENCH; ENGLISH summary (For primary document see N86-26468 17-28)
Avail: NTIS HC A09/MF A01

The investigation of the combustion of solid propellants based on HMX and energetic binder was carried out through the study of HMX and the energetic binder in self-burning, as well as that of their combination in propellants. The condensed phase behavior of the components was looked into by means of thermogravimetric analysis, differential scanning calorimetry, ignition and temperature (microthermocouples) profile measurements, as well as sampling and analysis of the gases produced from the condensed phase. At very low pressure, HMX sustains a staged flame, much like that of homogeneous propellants. The behavior of the binder is close to that of homogeneous propellants. The burning rate of the propellant is a compromise between the rates of the components, without interaction between the HMX flame and that of the binder. Author

N86-26471# Prins Maurits Lab. TNO, Rijswijk (Netherlands).
STABILITY OF NITROCELLULOSE PROPELLANTS ASSESSED VIA THERMAL DECOMPOSITION AND ALTERATION OF THE STABILIZER COMPOSITION
P. vandeMey and A. H. Heemskerk *In* AGARD Smokeless Propellants Jan. 1986 p 9-1 - 9-8 (For primary document see N86-26468 17-28)
Avail: NTIS HC A09/MF A01

In the Netherlands the surveillance of propellants is performed by investigating the thermal behavior of the propellant at a temperature of 358 K. This procedure is accepted to represent a degradation equivalent to a storage period of at least ten years at ambient temperatures. To obtain additional information about the degradation of propellants thermal stability tests were performed at various temperatures and under several environmental conditions. Both the thermal behavior of the propellants and the chemical behavior of the stabilizing amine compound were determined during these experiments. The composition of the amine compounds was analyzed using HPLC techniques developed for these experiments. Author

N86-26472# Consiglio Nazionale delle Ricerche, Milan (Italy).
BURNING STABILITY OF DOUBLE BASE PROPELLANTS
L. DeLuca, C. Zanotti, G. Riva, R. Donde, A. Volpi, C. Grimaldi, and G. Colombo *In* AGARD Smokeless Propellants Jan. 1986 p 10-1 - 10-17 (For primary document see N86-26468 17-28)
Avail: NTIS HC A09/MF A01

The nonsteady combustion and intrinsic burning stability of double base propellants are studied. Experimental results show that, over a large pressure range, the energetics and the dynamics of double base combustion is controlled by the fizz zone. This permits the classical quasi-steady gas phase assumption to be applied. However, a novel transient flame model is required, since the fizz zone, although thin in time, is thick in space. This novel transient flame model includes several previous models as particular cases; in addition it allows an already existing nonlinear burning stability theory to be immediately applied to double base combustion. In general, double base burning is found to be less stable than composite propellant burning, both statically and dynamically. This is due to the relatively little energy stored in the condensed phase and elongated fizz zone yielding a weak energy coupling at the burning surface. Author

N86-26473# IMI Summerfield, Kidderminster (England).
ELASTOMER MODIFIED CAST DOUBLE BASE PROPELLANTS
G. I. Evans and D. Facer *In* AGARD Smokeless Propellants Jan. 1986 p 13-1 - 13-17 (For primary document see N86-26468 17-28)
Avail: NTIS HC A09/MF A01

Cast double base propellants have many attractive features for tactical missile systems, not least where plume signature transparency is at a premium. However, such propellants are limited in mechanical properties, particularly strain capability at low temperatures of -40 C or less. The development of a new class of CDB propellants is described utilizing an elastomer in the binder. The advantages, properties and performance of these EMCDB propellants are given. The field of candidate polymer systems is explored with test results and chemistry of the binder together with the criteria leading to the selection of suitable elastomer binders. Author

N86-26474# IMI Summerfield, Kidderminster (England).
THE REDUCTION OF EXHAUST SIGNATURE IN SOLID PROPELLANT ROCKET MOTORS
G. I. Evans and P. K. Smith *In* AGARD Smokeless Propellants Jan. 1986 p 16-1 - 16-16 (For primary document see N86-26468 17-28)
Avail: NTIS HC A09/MF A01

An important feature of cast double base propellants is that during combustion the propellant itself produces extremely low levels of exhaust smoke. Developments in insulation material and, in particular, charge inhibitors have allowed the low smoke potential of the propellant to be fully realized in rocket motor firings. A further dramatic reduction in exhaust signature was obtained by suppressing secondary combustion in the rocket motor. This was achieved over a wide range of typical propellant charge and motor configurations using propellant additives. Flame suppressed plumes offer the desirable property of low exhaust emissions both in the visible and IR regions of the electromagnetic spectrum. Similarly missile communications both at optical and radio frequency wavelengths are improved by the absence of secondary combustion. The inhibitor and propellant developments concerned are reviewed and the reductions in exhaust signature which are obtained by the optimized use of secondary flame suppression is quantified. Author

N86-26475# Nobel's Explosives Co. Ltd., Stevenston (England). Defence and Aerospace Research.
THE CHEMICAL INTERACTION OF BALLISTIC MODIFIERS IN CDB PROPELLANT: ITS EFFECT UPON BALLISTICS AND STABILITY
J. D. M. Pearson, A. C. J. Shedden, and I. A. Duncan *In* AGARD Smokeless Propellants Jan. 1986 p 17-1 - 17-15 (For primary document see N86-26468 17-28)
Avail: NTIS HC A09/MF A01

During the development of a platonized cast double base propellant it was noted that a spread of burning rates from batch to batch was obtained. Subsequently batches of the propellant presistantly showed a marked decrease in gas crack lifetime, on accelerated aging, compared with earlier satisfactory results. Extensive work showed the stability problem to be associated with a chemical reaction between the ballistic modifiers. This reaction was reproduced in the laboratory, while at the same time the ballistic variability of the propellant was under investigation. It became apparent that the chemical interaction between the modifiers affected the propellant platonized burning rate and that the by products of this reaction cause the accelerated aging problem. This understanding allowed a new ballistic modifier to be developed which helped solve the stability problem while at the same time gave much more reproducible ballistics. Author

N86-26476# Defence Research Establishment Valcartier (Quebec).
DIRECT EROSIVE BURNING MEASUREMENTS OF A REDUCED-SMOKE SOLID PROPELLANT ROCKET BY FLASH X-RAYS
T. Constantinou and D. Greatrix (Toronto Univ., Ontario) *In* AGARD Smokeless Propellants Jan. 1986 p 18-1 - 18-13 (For primary document see N86-26468 17-28)
Avail: NTIS HC A09/MF A01

Despite the multitude of models available, proper erosive burning modelling continues to be a difficult task in the internal

ballistic prediction of solid propellant rockets with high volumetric loading. The majority of models are based on erosive burning measurements using small motors, window motors and with such techniques as imbedded probes or interrupted burning. Such methods, however, are not believed to exhibit the real combustion process. The flash X-ray technique using full sized motors gives a more realistic measurement of burning rates. This technique can be used to evaluate the internal ballistic code with different erosive burning models, a pressure-time record can be obtained and compared to experimental data. A comparison and evaluation of the different models, is thus possible. Data based on static firings of reduced smoke motors were analyzed by the above method and the results are presented. Author

N86-26477# Naval Postgraduate School, Monterey, Calif.
EXPERIMENTAL TECHNIQUES FOR OBTAINING PARTICLE BEHAVIOR IN SOLID PROPELLANT COMBUSTION
David W. Netzer and John P. Powers *In* AGARD Smokeless Propellants Jan. 1986 p 19-1 - 19-17 (For primary document see N86-26468 17-28)
Avail: NTIS HC A09/MF A01

A continuing investigation is being conducted to develop techniques to obtain quantitative data that can be used to relate solid rocket propellant composition and operating environment to the behavior of solid particulates within the grain port and exhaust nozzle. The techniques employed are high speed motion pictures of propellant strand burners and slab burners in a cross flow environment, SEM analysis of post fire residue (strand, slab, and motor), determination of D sub 32 across the exhaust nozzle using measurements of scattered laser light, and holograms of burning propellant strands, slabs and motors. In addition, techniques are being studied for automatic retrieval of particle size distributions from holograms taken of the combustion of solid propellants. Actual particle sizes of burning aluminum particles were obtained in high speed motion pictures by using high intensity rear illumination of the burning propellants to eliminate the flame envelopes surrounding the burning particles. Measurements of diffractively scattered light were made for determination of changes in D sub 32 across a solid propellant rocket motor exhaust nozzle. Two dimensional motors were employed to obtain holograms of propellant burned in a cross flow environment. Other efforts were directed at reduction of speckle in the recorded holograms and optimization of techniques for minimizing excessive smoke in the recorded scenes. A computer controlled Quantimet 720 is being used in an effort to obtain particle size distributions from reconstructed holograms. Author

N86-26478# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
GAS ANALYSIS FOR THE INVESTIGATION OF THE COMBUSTION OF DOUBLE-BASE PROPELLANTS AND HMX
Jean-Francois Trubert *In its* Smokeless Propellants (AGARD-CP-391) Jan. 1986 p 20-1 - 20-14 (For primary document see N86-26468 17-28)
Avail: NTIS HC A09/MF A01

The linear pyrolysis method under vacuum by conduction and radiation, with analysis by mass spectrometry is used to obtain the composition of the gases produced by solid propellant condensed phase degradation, while minimizing the secondary reactions and under conditions close to actual burning. This method was elaborated with reference to double base propellants, and in the presence of additives. Important quantities of formaldehyde, glyoxal and carbon dioxide are obtained. The presence of low amounts of nitrogen and carbon monoxides, carbon dioxide and water indicates that the gases result mostly from the degradation. The small difference between the quantitative compositions shows that the additive does not act on the condensed phase degradation. This method was applied to HMX. The analysis shows large amounts of several nitrogen oxides (NO2, NO, N2O), formaldehyde, and cyanhydric acid, and small quantities of water, nitrogen and carbon oxides. Author

N86-26479# Brigham Young Univ., Provo, Utah. Dept. of Chemical Engineering.
MEASUREMENTS OF DISTRIBUTED COMBUSTION
M. W. Beckstead, P. C. Braithwaite, and D. L. Gordon *In* AGARD Smokeless Propellants Jan. 1986 p 21-1 - 21-12 (For primary document see N86-26468 17-28)
Avail: NTIS HC A09/MF A01

Acoustic suppressants are commonly added to low smoke and smokeless propellants to avoid the problem of combustion instability. Although some suppressants are considered to be inert, most actually react with the combustion products. If a particle reacts while traversing a relatively large portion of the system, the interchange of energy between the burning particle and the acoustic environment can result in either a driving or damping contribution to the acoustics of the system, which is referred to as distribution combustion. Instead of using actual solid propellants, and experimental technique was developed to study this mechanism utilizing a gas fired Rijke burner. Advantages of this approach allow testing an additive independent of the propellant burning surface, avoiding the use of solid propellants, and allowing for independent control of frequency, O/F ratio, temperature, and particle addition. Al and ZrC are additives commonly used in solid propellants to suppress combustion instability. Experimental results obtained using Al and ZrC in the Rijke burner indicate that both additives cause an increase in the acoustic growth rate when compared to growth rates obtained without any particles in the system. The increase caused by Al is significantly greater that that caused by ZrC, which is expected because the reaction of Al releases more than twice the energy ZrC does. The increase in the acoustic growth rate due to distributed combustion was found to be directly related to the heat of reaction. Author

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N86-26480# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Geotechnical Lab.
COMPARATIVE STUDY OF NONDESTRUCTIVE PAVEMENT TESTING, WES (WATERWAYS EXPERIMENT STATION) NDT (NONDESTRUCTIVE TESTS) METHODOLOGIES Final Report
Jim W. Hall and Don R. Alexander Sep. 1985 66 p (AD-A163379; WES-MP-GL-85-26) Avail: NTIS HC A04/MF A01 CSCL 13/2

A demonstration of nondestructive airfield pavement evaluation procedures conducted by the US Army Engineer Waterways Experiment Station (WES) using both the WES 16-kip vibrator and a Dynatest falling weight deflectometer (FWD) is described. The nondestructive tests (NDT) were conducted at MacDill Air Force Base on five pavement test areas consisting of asphaltic concrete, portland cement concrete, and composite pavements. Two methods of data analysis were used. The dynamic stiffness modulus (DMS) method used dynamic deflection data from the WES 16-kip vibrator with a correlation analysis developed a number of years ago by WES. This method uses a correlation between the DSM (a load-deflection ratio) and the allowable load on a single wheel as derived from traditional test pit methods. The second analysis scheme used measured deflection basins at the pavement surface and layered elastic theory. Elastic moduli are computed by matching measured deflection basins with computed basins. Limiting stress/strain is then used to compute allowable aircraft loadings. This method was used with data from both the WES 16-kip vibrator and the FWD. Also demonstrated was a method of determining joint load transfer and of making appropriate adjustments to the allowable load to account for lack of load transfer. GRA

N86-26481# Ben Gurion Univ. of the Negev, Sede Boqer (Israel). Inst. for Desert Research.
OPERATIONAL SOIL MOISTURE PREDICTION MODEL Final

Report
Lev N. Gutman 20 Dec. 1985 65 p
(Contract DAJA45-84-C-0007)
(AD-A165313; AD-E301922) Avail: NTIS HC A04/MF A01 CSCL 08/13

The one dimensional problem of the diurnal variations of moisture and temperature at different depths of the thermally active, non-frozen, non-swelling soil layer is considered. It is assumed that we know: (1) Values of all meteorological elements at anemometer level at any time, (2) Moisture and temperature distribution with depths at some initial moment; and (3) Physical parameters and characteristics of the soil and vegetation cover which we shall call canopy for brevity. The model consists of: (1) Partial differential equations of the subsurface hydrology for a non-saturated vapor-liquid flow in the soil, allowing for the moisture removal by the roots of plants. (2) Algebraic empirical and ordinary differential equations for the description of the radiative and turbulent heat transfer between the atmosphere and the soil through the canopy allowing for the influence of condensation or evaporation at the foliage and also the retention of a part of the precipitation by the foliage. (3) Moisture and vapor balance equations at the surface of the soil. (4) Continuity conditions for heat and vapor fluxes at the top of the canopy. (5) Semiempirical algebraic equations of the type of surface layer equations for a thin atmospheric layer between the canopy and anemometer level. Results of computations are in agreement with experimental data. A few examples of soil moisture computations are presented together with experimental data. GRA

N86-26482# Mechanical Technology, Inc., Latham, N. Y.
IN-PROCESS CONTROL OF MACHINING. PHASE 1: MILLING
J. T. McCabe, Peter A. Albrecht, D. Locke, and Raymond A. Kirschbaum Sep. 1985 134 p
(Contract DAAA08-83-C-0052)
(AD-A165391; SARRI-EN-TR-85-01) Avail: NTIS HC A07/MF A01 CSCL 13/9

A system to control the path of a milling cutter was developed, integrated with a machining center, and demonstrated. Feedback control was based on measurements of machined edge coordinates taken behind the cutter. The demonstration consisted of milling four, parallel, identical, teardrop-shaped openings, spaced 90 degrees apart through the wall of an orifice tube. A linear diode array, sensitive to reflected light, was used to locate and record the edge profile of each opening. Real-time tool path redirection was based on a continual analysis of generated orifice area accumulation, thereby basing control of the machining process on area, the parameter which best reflected the function of the part. After the machining was completed, the optical edge sensor was used to inspect the part before it was removed from the machine. These processes resulted in significant improvements in productivity and quality. GRA

N86-26483# Ceres Corp., Waltham, Mass.
LINEAR RESONANCE COOLER
Apr. 1985 40 p
(Contract DAAK70-82-K-0222)
(AD-A165492) Avail: NTIS HC A03/MF A01 CSCL 13/1

The contract requires the incorporation of linear drive technology into a cryocooler design meeting the Specification for the US Army 1/4 Watt Common Module Cooler as closely as possible. The Resonant Cryocooler employs a concept using magnetic forces to linearly move dual opposed pistons in the compressor thus eliminating the use of rotary motors, crankshaft, greases and bearings. While not a requirement of the contract, the expander also employs a linear motor to control displacer stroking. This allows for electronic end stopping to mitigate microphonics problems. In addition, the ability to vary the waveform of the displacer motion and its phasing with respect to the compressor pressure wave form in order to optimize performance offers the potential for extending the operational life of the cooler. GRA

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

N86-26484*# Ohio State Univ., Columbus. ElectroScience Lab.
AN E-PLANE ANALYSIS OF APERTURE-MATCHED HORN ANTENNAS USING THE MOMENT METHOD AND THE UNIFORM GEOMETRICAL THEORY OF DIFFRACTION
D. J. Heedy and W. D. Burnside Sep. 1984 114 p refs
(Grant NsG-1613)
(NASA-CR-176841; NAS 1.26:176841; OSU-TR-716148-1) Avail: NTIS HC A06/MF A01 CSCL 20N

The moment method and the uniform geometrical theory of diffraction are utilized to obtain two separate solutions for the E-plane field pattern of an aperture-matched horn antenna. This particular horn antenna consists of a standard pyramidal horn with the following modifications: a rolled edge section attached to the aperture edges and a curved throat section. The resulting geometry provides significantly better performance in terms of the pattern, impedance, and frequency characteristics than normally obtainable. The moment method is used to calculate the E-plane pattern and BSWR of the antenna. However, at higher frequencies, large amounts of computation time are required. The uniform geometrical theory of diffraction provides a quick and efficient high frequency solution for the E-plane field pattern. In fact, the uniform geometrical theory of diffraction may be used to initially design the antenna; then, the moment method may be applied to fine tune the design. This procedure has been successfully applied to a compact range feed design. Author

N86-26485*# Ohio State Univ., Columbus. ElectroScience Lab.
MOMENT METHOD ANALYSIS OF MICROSTRIP ANTENNAS OVER A WIDE FREQUENCY RANGE
B. W. Kwan and E. H. Newman Feb. 1985 61 p
(Grant NsG-1613)
(NASA-CR-176842; NAS 1.26:176842; OSU-TR-716148-4) Avail: NTIS HC A04/MF A01 CSCL 20N

Expressions for the self and mutual impedance between microstrip antenna modes on a grounded dielectric slab are presented. The mutual impedance between the microstrip modes and a vertical current filament in the dielectric is also presented. These are the quantities required in a method of moments analysis of the microstrip antenna. Entire domain expansion modes, suitable for representing the microstrip current over a broad frequency range, are used. Efficient methods for the evaluation of the mutual impedance elements are described. Author

N86-26486*# Ohio State Univ., Columbus. ElectroScience Lab.
ASYMPTOTIC HIGH FREQUENCY ANALYSIS OF THE ELECTROMAGNETIC BACKSCATTERING FROM AN INLET MODEL CONSISTING OF PIECEWISE LINEARLY TAPERED SECTIONS
A. Altintas and P. H. Pathak Nov. 1985 146 p refs
(Grant NsG-1613)
(NASA-CR-176844; NAS 1.26:176844; OSU-TR-716148-6) Avail: NTIS HC A07/MF A01 CSCL 20N

Electromagnetic backscattering from an open ended three dimensional inlet model is analyzed and computed patterns are compared with results of experimental measurements. The model is comprised of two sections. The first section consists of a linearly tapered waveguide with a rectangular opening at one end and the other end is connected to the second section which is a uniform rectangular waveguide with a planar perfectly conducting termination. The model is electrically large so that many propagating modes are excited. The method of analysis contains conventional aperture integration and modal techniques combined with high frequency techniques, which employ concepts such as modal rays, geometrical theory of diffraction and equivalent currents. For the cases considered, it is shown that only a few of the many

propagating modes contribute appreciably to the backscattered field. These modes are selected according to their modal ray angle directions. Author

N86-26487*# Ohio State Univ., Columbus. ElectroScience Lab.
SIMULATION OF AN AIRCRAFT FLYING THROUGH A GROUND STATION TO SATELLITE LINK
R. C. Rudduck, W. D. Burnside, A. K. Dominek, and T. H. Lee Feb. 1986 52 p ref
(Grant NsG-1613)
(NASA-CR-176845; NAS 1.26:176845; OSU-TR-716148-7) Avail: NTIS HC A04/MF A01 CSCL 20N

The effect of an aircraft which flies through a ground station-to-satellite link is determined. There are two aspects to the work reported here: (1) an aperture blockage theoretical solution developed by Rudduck and Lee was used to calculate the effect of a large aircraft (C5) for various satellite ground station antenna diameters, and (2) the compact range facility at the Ohio State University was used to measure various targets, including a 737 aircraft, and to validate the theoretical solution in item 1. Author

N86-26488# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
THE NEGLIGIBLE EFFECT OF NON-GAUSSIAN SURFACE DEVIATIONS IN LARGE MM-LAMBDA REFLECTORS' APERTURE EFFICIENCY AND THE PERFORMANCE OF ITAPETINGA 45-FT ANTENNA AT LAMBDA = 3.3 MM
P. Kaufmann, Z. Abraham, E. Scalise, Jr., R. E. Schaal, J. L. MonteirodoVale, and J. W. S. Vilas Boas 2 Jul. 1986 18 p Submitted for publication. Sponsored in part by FINEP
(INPE-3837-PRE/908) Avail: NTIS HC A02/MF A01

The aperture efficiency at lambda = 3.3 mm of the 45-ft Itapetinga reflector was found to be about 25 percent. This radiometric result suggests an equivalent surface accuracy of less than 0.25 mm, root-sum-square (rss), assuming a Gaussian distribution of errors, which is smaller than the actual rss estimated for the dish, and represents a 5 dB improvement in gain. This result confirms that non-Gaussian errors across a smooth surface have negligible effects on the aperture efficiency, and that antenna efficiency may be predicted from mechanical measurements when the slowly varying errors across the source are known. It is possible to predict that relatively simple mechanical readjustments of the reflector and subreflector may raise its efficiency to 30 percent. Author

N86-26489*# Operations Research, Inc., Silver Spring, Md.
SPECTRUM ORBIT UTILIZATION PROGRAM TECHNICAL MANUAL SOUP5 VERSION 3.8
J. Davidson, H. R. Ottey, P. Sawitz, and F. S. Zusman 13 Dec. 1984 77 p refs
(Contract NAS3-22885)
(NASA-CR-174944; NAS 1.26:174944; TR-2390) Avail: NTIS HC A05/MF A01 CSCL 17B

The underlying engineering and mathematical models as well as the computational methods used by the SOUP5 analysis programs, which are part of the R2BCSAT-83 Broadcast Satellite Computational System, are described. Included are the algorithms used to calculate the technical parameters and references to the relevant technical literature. The system provides the following capabilities: requirements file maintenance, data base maintenance, elliptical satellite beam fitting to service areas, plan synthesis from specified requirements, plan analysis, and report generation/query. Each of these functions are briefly described. B.G.

N86-26490# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DATA TRANSMISSION SYSTEMS
1986 4 p
(AD-A163778; FTD-ID(RS)T-0037-86) Avail: NTIS HC A02/MF A01 CSCL 17/2

This standard establishes the nominal speeds of data transmission through telegraph channels, voice-frequency channel, broadband channel, short wave radio channels, and, also, types of redundant codes for the data transmission systems through standard voice frequency channels synchronously with a narrowband feedback channel. The standard takes in to account the specifications from the recommendation made by CMEA on the standardization of PS 2344-70. GRA

N86-26491# Electrospace Systems, Inc., Arlington, Va.
ELECTROMAGNETIC PULSE/TRANSIENT THREAT TESTING OF PROTECTION DEVICES FOR AMATEUR/MILITARY AFFILIATE RADIO SYSTEM EQUIPMENT. VOLUME 1
Dennis Bodson, Joseph Frizzell, Thomas Higdon, and Walter Rabke 31 Oct. 1985 205 p refs
(Contract DCA100-85-C-0010)
(AD-A164430; NCS-TIB-85-10-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 20/14

This technical report discusses the vulnerability of equipment used by amateur/MARS radio operators in the United States to disruption or damage by transient electromagnetic effects such as lightning, voltage surges, and electromagnetic pulse (EMP) waves. It also reports the results of two test programs; one to evaluate existing transient suppression devices and components, and one to evaluate the response of amateur radio equipment to an EMP transient environment. Based on the test results, the report recommends procedures and a low-cost installation scheme which will significantly increase the operational survivability of amateur type communications equipment in a lightning or EMP environment. Volume 1 contains the test results and recommendations for transient protection of amateur radio equipment. B.G.

N86-26492# Electrospace Systems, Inc., Arlington, Va.
ELECTROMAGNETIC PULSE/TRANSIENT THREAT TESTING OF PROTECTION DEVICES FOR AMATEUR/MILITARY AFFILIATE RADIO SYSTEM EQUIPMENT. VOLUME 2
Dennis Bodson, Joseph Frizzell, Thomas Higdon, and Walter Rabke 31 Oct. 1985 141 p refs
(Contract DCA100-85-C-0010)
(AD-A164431; NCS-TIB-85-10-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 20/14

The vulnerability of equipment used by amateur/MARS radio operators in the United States to disruption or damage by transient electromagnetic effects such as lightning, voltage surges, and electromagnetic pulse (EMP) waves is discussed. The supporting documentation for the protective device qualification program includes: the test plan for the two EMP tests, descriptions/specifications of the tested transient suppression devices and the amateur radio equipment, and photographs of the test facilities and test set-ups. GRA

N86-26493# Electrospace Systems, Inc., Arlington, Va.
ELECTROMAGNETIC PULSE/TRANSIENT THREAT TESTING OF PROTECTION DEVICES FOR AMATEUR/MILITARY AFFILIATE RADIO SYSTEM EQUIPMENT. VOLUME 3. TEST DATA, ELECTROMAGNETIC PULSE TESTING OF PROTECTION DEVICES. SECTION 1. HIGH ENERGY PULSE-DEVICE FAILURE TEST. 50 OHMS IMPEDANCE 25,000 VOLTS-4000 AMPS, 100 JOULES
Dennis Bodson, Joseph Frizzell, Thomas Higdon, and Walter Rabke 31 Oct. 1985 217 p refs
(Contract DCA100-85-C-0010)
(AD-A164432; NCS-TIB-85-10-Vol-3-Sec-1) Avail: NTIS HC A10/MF A01 CSCL 20/14

The results of two test programs: one to evaluate existing transient suppression devices and components, and one to evaluate the response of amateur radio equipment to an electromagnetic pulse (EMP) transient environment are presented. Raw test data in the form of oscilloscope photographs for high energy pulse-device failure tests at 50 ohms impedance, 25000 volts, 400 amps, and 100 joules are presented. Analysis of the test data is being made. GRA

N86-26494# Electrospace Systems, Inc., Arlington, Va.
ELECTROMAGNETIC PULSE/TRANSIENT THREAT TESTING

OF PROTECTION DEVICES FOR AMATEUR/MILITARY AFFILIATE RADIO SYSTEM EQUIPMENT. VOLUME 3. TEST DATA, ELECTROMAGNETIC PULSE TESTING OF PROTECTION DEVICES. SECTION 2. HIGH IMPEDANCE/HIGH VOLTAGE TEST 50 OHMS-4500 VOLTS

Dennis Bodson, Joseph Frizzell, Thomas Higdon, and Walter Rabke
31 Oct. 1985 287 p refs
(Contract DCA100-85-C-0010)
(AD-A164433; NCS-TIB-85-10-Vol-3-Sec-2) Avail: NTIS HC A13/MF A01 CSCL 20/14

The results of two test programs: one to evaluate existing transient suppression devices and components, and one to evaluate the response of amateur radio equipment to an EMP transient environment are reported. Raw test data in the form of oscilloscope photographs for high impedance/high voltage tests at 50 ohms and 4500 volts are presented. GRA

N86-26495# Electrospace Systems, Inc., Arlington, Va.
ELECTROMAGNETIC PULSE/TRANSIENT THREAT TESTING OF PROTECTION DEVICES FOR AMATEUR/MILITARY AFFILIATE RADIO SYSTEM EQUIPMENT. VOLUME 3. TEST DATA, ELECTROMAGNETIC PULSE TESTING OF PROTECTION DEVICES. SECTION 3. LOW IMPEDANCE/HIGH VOLTAGE TEST, 5 OHMS-4500 VOLTS-1000 AMPS

Dennis Bodson, Joseph Frizzell, Thomas Higdon, and Walter Rabke
31 Oct. 1985 200 p refs
(Contract DCA100-85-C-0010)
(AD-A164434; NCS-TIB-85-10-Vol-3-Sec-3) Avail: NTIS HC A09/MF A01 CSCL 20/14

The results of two test programs: one to evaluate existing transient suppression devices and components, and one to evaluate the response of amateur radio equipment to an EMP transient environment are reported. Raw test data in the form of oscilloscope photographs for low impedance/high voltage tests at 5 ohms, 4500 volts, and 1000 amps are presented. Analysis of the test data is being made. GRA

N86-26496# Electrospace Systems, Inc., Arlington, Va.
ELECTROMAGNETIC PULSE/TRANSIENT THREAT TESTING OF PROTECTION DEVICES FOR AMATEUR/MILITARY AFFILIATE RADIO SYSTEM EQUIPMENT. VOLUME 3. TEST DATA, ELECTROMAGNETIC PULSE TESTING OF PROTECTION DEVICES. SECTION 4. LOW IMPEDANCE/LOW VOLTAGE TEST, 5 OHMS-600 VOLTS-120 AMPS

Dennis Bodson, Joseph Frizzell, Thomas Higdon, and Walter Rabke
31 Oct. 1985 199 p refs
(Contract DCA100-85-C-0010)
(AD-A164435; NCS-TIB-85-10-Vol-3-Sec-4) Avail: NTIS HC A09/MF A01 CSCL 20/14

The results of two test programs are presented: one to evaluate existing transient suppression devices and components, and one to evaluate the response of amateur radio equipment to an EMP transient environment. Raw test data in the form of oscilloscope photographs for low impedance/low voltage test at 5 ohms, 600 volts, and 120 amps are presented. Analysis of the test data is being made. GRA

N86-26497# Electrospace Systems, Inc., Arlington, Va.
ELECTROMAGNETIC PULSE/TRANSIENT THREAT TESTING OF PROTECTION DEVICES FOR AMATEUR/MILITARY AFFILIATE RADIO SYSTEM EQUIPMENT. VOLUME 3. TEST DATA, ELECTROMAGNETIC PULSE TESTING OF PROTECTION DEVICES. SECTION 5. EQUIPMENT AND DEVICES OSCILLOSCOPE PHOTOGRAPHS

Dennis Bodson, Joseph Frizzell, Thomas Higdon, and Walter Rabke
31 Oct. 1985 134 p refs
(Contract DCA100-85-C-0010)
(AD-A164436; NCS-TIB-85-10-Vol-3-Sec-5) Avail: NTIS HC A07/MF A01 CSCL 20/14

The results of two test programs are presented: one to evaluate existing transient suppression devices and components, and one to evaluate the response of amateur radio equipment to an EMP transient environment. Oscilloscope photographs of the following equipment are presented: Mosley TA33JR antenna, rectangular sensor, ground wire antenna, Crushcraft AV-5 antenna, round H sensor, battery charger, rubber duck antenna, Fisher unit, H field sensors, and direct current power supply. Analysis of the test data is being made. GRA

N86-26498# Electrospace Systems, Inc., Arlington, Va.
ELECTROMAGNETIC PULSE/TRANSIENT THREAT TESTING OF PROTECTION DEVICES FOR AMATEUR/MILITARY AFFILIATE RADIO SYSTEM EQUIPMENT. VOLUME 3. TEST DATA, ELECTROMAGNETIC PULSE TESTING OF PROTECTION DEVICES. SECTION 6. EQUIPMENT AND DEVICES BENCH CHECK MEASUREMENT

Dennis Bodson, Joseph Frizzell, Thomas Higdon, and Walter Rabke
31 Oct. 1985 176 p refs
(Contract DCA100-85-C-0010)
(AD-A164437; NCS-TIB-85-10-Vol-3-Sec-6) Avail: NTIS HC A09/MF A01 CSCL 20/14

The results of two test programs are presented: one to evaluate existing transient suppression devices and components, and one to evaluate the response of amateur radio equipment to an EMP transient environment. Oscilloscope photographs of the following transmitters/receivers are included: YAESU FT 726R, YAESU F7 757GX, ICOM IC-745, ICOM IC-27A, ICOM IC-02AT, ICOM IC-271A, ICOM IC-471A, Kenwood TS-4305, Kenwood TR-2600, Kenwood 7930, and Swan 250. GRA

N86-26499# Electrospace Systems, Inc., Arlington, Va.
ELECTROMAGNETIC PULSE/TRANSIENT THREAT TESTING OF PROTECTION DEVICES FOR AMATEUR/MILITARY AFFILIATE RADIO SYSTEM EQUIPMENT. VOLUME 3. TEST DATA, ELECTROMAGNETIC PULSE TESTING OF PROTECTION DEVICES. SECTION 7. EQUIPMENT AND DEVICES TEST DESCRIPTIONS

Dennis Bodson, Joseph Frizzell, Thomas Higdon, and Walter Rabke
31 Oct. 1985 118 p refs
(Contract DCA100-85-C-0010)
(AD-A164438; NCS-TIB-85-10-Vol-3-Sec-7) Avail: NTIS HC A06/MF A01 CSCL 20/14

The results of two test programs are presented: one to evaluate existing transient suppression devices and components, and one to evaluate the response of amateur radio equipment to an EMP transient environment. Equipment descriptions, purposes, and configurations are presented. Pulser field, power, antenna, power protection device, radio frequency protection device, and injection parameters are reported. GRA

N86-26500# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
MODEL STUDIES OF SURFACE NOISE INTERFERENCE IN GROUND-PROBING RADAR

Steven A. Arcone and Allan J. Delaney Nov. 1985 23 p
(AD-A163208; CRREL-85-19) Avail: NTIS HC A02/MF A01 CSCL 17/9

Ground-probing radar can be an effective tool for exploring the top 10 to 20 m of ground, especially in cold regions where the freezing of water decreases signal absorption. However, the large electrical variability of the surface, combined with the short wavelengths used, can often cause severe ground clutter that can mask a desired, deeper return. In this study a model facility was constructed consisting of a metallic reflector covered by sand. Troughs of saturated sand were emplaced at the surface to carry surface electrical properties and to act as a noise source to interfere with the bottom reflections. Antenna polarization and height, and signal stacking in both static (antennas stationary) and dynamic (antennas moving) modes were then investigated as methods for reducing the surface clutter. Polarization parallel to the profile direction (perpendicular to the troughs' axes) gave profiles superior to the perpendicular case because of the dimensional sensitivity of the antenna radiation. Dynamic stacking greatly improved the signal-to-noise ratio because noise sources were averaged as the antennas moved, while the desired reflector, buried at constant depth, was enhanced. Raising the antennas above the surface

also reduced noise because the surface area over which reflections were integrated increased. All three noise reduction techniques could be effective in surveys for reflectors at nearly constant depth such as groundwater tables or ice/water interfaces.
Author (GRA)

N86-26501# Human Engineering Labs., Aberdeen Proving Ground, Md.
A COMPARISON OF VOICE AND KEYBOARD DATA ENTRY FOR A HELICOPTER NAVIGATION TASK Final Report
Frank J. Malkin and Kathleen A. Christ Dec. 1985 42 p
(AD-A163245; HEL-TM-17-85) Avail: NTIS HC A03/MF A01 CSCL 17/2

The Doppler navigation set, AN/ASN 128 was used to compare manual keyboard data entry of navigation map coordinates with an isolated-word speech recognition system. Twelve male Army aviators entered data by keyboard and by voice while controlling a helicopter flight simulator. The results indicated that although the keyboard mode was faster than the voice mode of data entry, the aviators preferred using voice. Voice data entry was perceived as requiring less effort and reducing pilot workload. However, the relative slowness and low accuracy (85.5 percent) of voice data entry highlight the limitations that may exist for speech recognition systems in performing time or task critical functions. GRA

N86-26502# Massachusetts Inst. of Tech., Cambridge. Lab. for Information Decision Systems.
A SCHEDULE-BASED APPROACH FOR FLOW-CONTROL IN DATA COMMUNICATION NETWORKS Ph.D. Thesis
Utpal Mukherji Jan. 1986 120 p
(Contract N00014-84-K-0357; Grant NSF ECS-83-10698; DARPA Order 3045)
(AD-A163253; LIDS-TH-1527) Avail: NTIS HC A06/MF A01 CSCL 17/2

An approach for achieving user-session packet throughput guarantees and packet intranetwork delay limits is described. Both objectives are important for packetized voice calls. The approach permits flexible usage of link capacity by sessions, which is important for data sessions. Throughput is guaranteed to a session at links in its path by scheduling priority-slots in link-frames for transmission. An extension of end-to-end windowing limits the intra-network delay for a session to the sum of, first, the product of the frame-time and the session's window-size, and, second the session's priority-slot schedule-delay. An NP-completeness result is proven, showing, for general networks, that the scheduling of priority-slots to obtain minimum sum of schedule-delays is algorithmically hard. Minimum-delay scheduling algorithms for special network classes, and a scheduling heuristic for general networks, are presented. For Poisson packet generation at session rates less than throughput guarantees, limited simulations suggest that low mean values of packet end-to-end delays, relatively insensitive to choice of window-sizes, are obtained even at small but non-zero window-sizes. GRA

N86-26503# Naval Research Lab., Washington, D. C.
THREE-DIMENSIONAL NUMERICAL SIMULATIONS OF FELs BY TRANSVERSE MODE SPECTRAL METHOD
Cha-Mei Tang and P. Sprangle 30 Dec. 1985 28 p
(AD-A163297; NRL-MR-5694) Avail: NTIS HC A03/MF A01 CSCL 20/5

A numerical method is presented for solving a three-dimensional radiation field by decomposing the radiation field into transverse modes that satisfy the free space wave equation and the boundary conditions. The formalism includes betatron oscillations in a realizable wiggler, finite emittance and energy spread in an amplifier or oscillator configuration. This formalism can be generalized to calculate sidebands resulting from the synchrotron oscillations. The transverse mode spectral method is compared with the finite difference method, spectral method and transform spectral method. Examples from a computer code using Gaussian-Hermite expansion are given. Self-focusing of the radiation beam due to gain and refraction of the Free Electron Laser is shown. GRA

N86-26504# Rome Air Development Center, Griffiss AFB, N.Y.
A COMPARATIVE ANALYSIS OF WHISPERED AND NORMALLY PHONATED SPEECH USING AN LPC-10 VOCODER
Johnny B. Wilson and James D. Mosko Dec. 1985 36 p
(AD-A163307; RADC-TR-85-264) Avail: NTIS HC A03/MF A01 CSCL 17/2

The determination of the performance of an LPC-10 vocoder in the processing of adult male and female whispered and normally phonated connected speech was the focus of this study. The LPC-10 vocoder's analysis of whispered speech compared quite favorably with similar studies which used sound spectrographic processing techniques. Shifting from phonated speech to whispered speech caused a substantial increase in the phonomic formant frequencies and formant bandwidths for both male and female speakers. The data from this study showed no evidence that the LPC-10 vocoder's ability to process voices with pitch extremes and quality extremes was limited in any significant manner. A comparison of the unprocessed natural vowel waveforms and qualities with the synthesized vowel waveforms and qualities revealed almost imperceptible differences. An LPC-10 vocoder's ability to process linguistic and dialectical suprasegmental features such as intonation, rate and stress at low bit rates should be a critical issue of concern for future research. GRA

N86-26505# Defense Communications Agency, Arlington, Va.
DEFENSE COMMUNICATIONS AGENCY COST AND PLANNING FACTORS MANUAL, CHANGE 2
23 Sep. 1985 176 p
(AD-A163319; DCA-CIRC-600-60-1-CH-2) Avail: NTIS HC A09/MF A01 CSCL 17/2

Line-of-sight (LOS) microwave systems normally use the frequency spectrum from 2 to 12 gigahertz (GHz). The LOS path lengths range from 1 to 100 miles depending upon propagation, terrain, frequency, and tower height, among other engineering considerations. The average system consists of path lengths of approximately 30 miles. The total microwave system consists of terminals, relays, and normal support functions required for any communications system, such as technical control, multiplex, utilities, land, and buildings. LOS microwave transmission is usually dual diversity, using either frequency, space, or polarization diversity. The transmission system will generally contain dual receive and transmit equipment at all locations for use as either frequency diversity systems or hot standby systems for redundancy. Two techniques may be employed for the transmission and multiplexing of communications circuits. DCS uses frequency modulation transmission and frequency division multiplex (FDM) also called analog systems. Currently DCS uses digital transmission and time division multiplex (TDM), referred to as digital systems. GRA

N86-26506# Syracuse Univ., N. Y. Dept. of Electrical and Computer Engineering.
ELECTROMAGNETIC PENETRATION THROUGH A SLOT INTO A RECTANGULAR WAVEGUIDE Interim Technical Report
Hu Zhenya and Roger F. Harrington Oct. 1985 52 p refs
(Contract DAAG29-84-K-0078)
(AD-A164590; SYRU/DECE/TR-85/4; ARO-21378.4-EL; ITR-3)
Avail: NTIS HC A04/MF A01 CSCL 20/3

Electromagnetic penetration into a matched rectangular waveguide through a longitudinal slot in a conducting plane is considered. The problem is divided into two parts, one in half space and another inside the waveguide, by use of the equivalence principle. The resultant equations are the same as some previously described, the only difference being that the excitation vector is changed from an incident wave inside the waveguide to an incident plane wave in half space. The magnetic current over the slot is obtained from the solution of the matrix equations. The electromagnetic penetration into a matched rectangular waveguide and the electromagnetic reradiation into half space through a slot are computed from the equivalent magnetic current over the slot.

The computed results show that a plane wave at normal incidence and a resonated slot near the side of the waveguide broad wall allow orders of magnitude greater power to penetrate into the waveguide than when the slot is not resonated. GRA

N86-26507# Pennsylvania State Univ., University Park. Dept. of Engineering Science and Mechanics.
COMPARISON OF THE COHERENT ATTENUATION PREDICTED BY SINGLE AND MULTIPLE SCATTERING THEORIES FOR THE CASE OF SEVERAL TYPES OF HYDROMETEORS
Yushieh Ma, Vijay K. Varadan, and Vasundara V. Varadan 31 Jan. 1986 62 p
(Contract DAAG29-84-K-0187)
(AD-A164635; ARO-21825.2-GS) Avail: NTIS HC A04/MF A01 CSCL 20/14

A systematic computation has been completed in order to compare the difference in the coherent attenuation predicted using multiple and single scattering theories. This is the first study in the literature to examine quantitative results based on two different scatterng theories. Therefore one is able to tell the approximate range, in both frequency and concentration regimes, where single scattering theory can be applied for different types of hydrometeors. However, the computations give exact figures up to the four decimal place and reveal that, in most cases, if interactions among scatterers are not considered, the coherent attenuation can either be over- or under-estimated. This is a serious problem in communications between distant stations. GRA

N86-26508# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.
A LOOP ANTENNA FOR A VLF (VERY LOW FREQUENCY) SATELLITE TRANSMITTER
H. C. Koons, M. H. Dazey, and D. C. Pridmore-Brown 30 Sep. 1985 43 p refs
(Contract F04701-83-C-0084)
(AD-A164652; TR-0084A(5723-01)-1; SD-TR-85-49) Avail: NTIS HC A03/MF A01 CSCL 17/2

The Space Sciences Laboratory of The Aerospace Corporation is currently defining an experiment to test a loop antenna configuration as a very low frequency (VLF) transmitter in the ionosphere. The experiment is sponsored by the Naval Air Systems Command. The primary objectives of the experiment are to validate existing models for radiation by a loop antenna and to study the performance of the antenna in the ionospheric plasma. The antenna will be carried into orbit in the payload bay of the Space Shuttle. During the radiation tests it will be deployed above the payload bay by the remote manipulator system. A VLF receiver aboard a subsatellite will be used to map the radiation pattern of the antenna by measuring the field intensities at distances of 1 to 100 Km from the transmitter. Calculations predict that the antenna impedance will only be slightly modified by the plasma and that the link to the receiver can be closed at distances well beyond 100 km. A one-third scale model of the antenna has been constructed. Impedance measurements have been made on the model in a 5-m diameter space plasma simulation chamber at NASA Lewis Research Center. The measurements confirm that the reactance of the antenna in an ionospheric plasma is essentially identical to its free space self-inductance. The effective series resistance of the circuit increases with frequency. The losses are attributed to power transferred to plasma turbulence. GRA

N86-26509# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Electrical and Computer Engineering.
MIXED-ORDER FINITE ELEMENTS FOR THE SOLUTION OF THREE-DIMENSIONAL ELECTROMAGNETIC FIELDS Interim Report, Sep. 1983 - Sep. 1984
Z. J. Cendes, D. Hudak, and D. Sun Jan. 1986 33 p
(Contract F19628-83-C-0079)
(AD-A164786; RADC-TR-85-158) Avail: NTIS HC A03/MF A01 CSCL 20/4

A new method of modeling electromagnetic waves by the finite element method is presented. The method is based on a numerical formulation in which different orders of polynomials are used to approximate the three different components of either the electric or the magnetic field vectors. It provides a reliable procedure for the finite element solution of three-dimensional electromagnetic field problems. Heretofore, such solutions were plagued by the presence of spurious modes. The new method is applied to the analysis of fields in resonant electromagnetic cavities. GRA

N86-26510# Ohio State Univ., Columbus. ElectroScience Lab.
RADAR TARGET CLASSIFICATION STUDIES: SOFTWARE DEVELOPMENT AND DOCUMENTATION
A. Kamis, F. Garber, and E. Walton Sep. 1985 68 p
(Contract N00014-84-K-0705)
(AD-A164789; ESL-716559-1) Avail: NTIS HC A04/MF A01 CSCL 17/9

Three computer programs were developed to process and analyze calibrated radar returns. The first program, called DATA-BASE, was developed to create and manage a random accessed data base. The second program, called FTRAN DB, was developed to process horizontal and vertical polarizations radar returns into different formats (i.e., time domain, circular polarizations and polarization parameters). The third program, called RSSE, was developed to simulate a variety of radar systems and to evaluate their ability to identify radar returns. Complete computer listings are included in the appendix volumes. GRA

N86-26511# Naval Postgraduate School, Monterey, Calif.
PROCESS SYNCHRONIZATION AND DATA COMMUNICATION BETWEEN PROCESSES IN REAL TIME LOCAL AREA NETWORKS M.S. Thesis
Reinhard Haeger Dec. 1985 113 p
(AD-A164860) Avail: NTIS HC A06/MF A01 CSCL 17/2

This thesis extends the multi-computer real-time executive, MCORTEX. The multiple cluster system RTC (Real Time Cluster Star), consisting of clusters of single board computers (INTEL iSBC 86/12A), which are connected via an Ethernet Local Area Network, serves as a hardware basis for the implementation of extended MCORTEX. The extension upgrades MCORTEX to system-wide synchronization and general data communication between any processes in the system. An intercluster shared memory model is developed, that partially replicates intracluster shared memory, such that shared data replication is minimized and the system's processing speed is maximized. This implementation, by transmitting produced shared data to all consuming clusters as soon as possible after production, guarantees that only cluster local hits occur in the system. Shared memory space is used efficiently by transmitting shared data to consuming clusters only, and by the ability to store shared data contiguously in intracluster shared memory. GRA

N86-26512# Princeton Univ., N. J. Information Sciences and Systems Lab.
ROBUST AND NONPARAMETRIC DETECTION OF FADING NARROWBAND SIGNALS Technical Report, Sep. 1983 - Aug. 1985
M. Weiss and Stuart C. Schwartz Jan. 1986 240 p refs
(Contract N00014-81-K-0146)
(AD-A164924; Rept-19) Avail: NTIS HC A11/MF A01 CSCL 17/9

This thesis deals primarily with the design and analysis of algorithms for detection of narrowband slowly fading signals, embedded in noise of uncertain distribution. The signal's phase and amplitude are random, but are essentially constant over the observation interval; in addition, the Doppler frequency of the signal is unknown. This is the most common model of target echoes received by radar or sonar systems. Attention is focused on i.i.d. noise samples whose marginal distribution belongs to an epsilon-mixture family, where the scale (variance) of the nominal part of the distribution is also unknown. This is an important generalization of the model. The purpose of the derived detection algorithms is two-fold: first, to assure constant probability of false alarm, regardless of the noise distribution (DF-CFAR); and second, to

achieve optimal maximin probability of detection (Pd) performance. GRA

N86-26513# Pennsylvania State Univ., University Park. Lab. for Electromagnetic and Acoustic Research.
EXACT CALCULATIONS OF FIRST ORDER CONTRIBUTIONS TO THE INCOHERENT INTENSITY
Vasundara V. Varadan, Yushieh Ma, and Vijay K. Varadan Jan. 1986 33 p refs
(Contract DAAG29-84-K-0187)
(AD-A164927; ARO-21825.1-GS) Avail: NTIS HC A03/MF A01 CSCL 14/5

Basic studies on the effect of inhomogeneities - via their geometry, size, material properties, distribution, multiple, scattering processes and statistical correlations in position and the effect of aligned versus randomly oriented non-spherical scatterers has continued this year. Emphasis has been on studies of the second moment of the field fluctuation, namely the incoherent intensity. The effects of completely correlated (identical) scatterers versus partially correlated scatterers (distinct) has been studied as a function of observation angle, non-dimensional wavenumber, and concentration. Due to the specific form of the expressions for the incoherent intensity, the effect of correlations is to decrease the value of the incoherent intensity, the effect of correlations is to decrease the value of the incoherent intensity. Since the correlation contribution is also very much angle dependent, the effects are more in some direction than in others. In every case both vertical and horizontal polarizations are studied and the differences in the results are discussed. The multiple amplitudes of the effective field exciting each scatterer are explicitily calculated leading to more accurate values of the second moment. It may be recalled that the effective field and the effective propagation constant are calculated in the Quasi Crystalline approximation and include the effects of pair correlation and sequential multiple scattering terms. Author (GRA)

N86-26514# M/A-COM Linkabit, Inc., Vienna, Va.
UHF DAMA (DEMAND-ASSIGNED MULTIPLE ACCESS) SIMULATION ANALYSIS Final Report, 7 Aug. - 27 Nov. 1985
G. Engel 27 Nov. 1985 287 p
(Contract DCA100-84-C-0009)
(AD-A165446; Rept-155; DCA/MSO-85-109A) Avail: NTIS HC A13/MF A01 CSCL 17/2

This manual is intended to provide comprehensive instructions on the use of the IBM-PC based Demand-Assigned Multiple access (DAMA) simulation environment. It presents information on the set up and loading of the various programs in the environment, as well as details on how to use each of the programs. All packages are structured as workspaces in the STSC Inc. version of the language APL*PLUS/PC. These programs will only run on an APL*PLUS/PC system, and it is assumed that the simulation user has a license for using APL*PLUS/PC from STSC. In the following section, an overview of the APL environment is presented. Each of the five following chapters document the five delivered workspaces (MODEL, BBNOISE, TDMA4N, TDMA4N, and DAMADR). Chapter 7 presents the results of the simulation validation effort. Chapter 8 gives a description of the noise model used in the simulation, as well as a user's guide to the noise simulation functions. Complete workspace documentation, including listings, cross-references, and function call trees are included as an appendix to this report. Author (GRA)

N86-26515# Stanford Telecommunications, Inc., McLean, Va.
USE OF LAN (LOCAL AREA NETWORK) TECHNOLOGY IN DSCS (DEFENSE SATELLITE COMMUNICATION SYSTEM) EARTH TERMINALS Final Report, Oct. 1985 - Feb. 1986
Alan Jacobsen and Matthew Griffin 20 Feb. 1986 212 p
(Contract DCA100-85-C-0062)
(AD-A165496; STI/E-TR-850156) Avail: NTIS HC A10/MF A01 CSCL 17/2

The report addresses the use of local area network (LAN) technology to support intercommunications within the Defense Satellite Communications Systems (DSCS) Earth terminals. A summary of local area network capabilities and options is provided as background material. Two types of device intercommunications are identified: the intercommunication of equipment to directly provide the circuit-switched channels needed for DSCS user circuits and the intercommunication of equipment in support of control and status monitoring functions. Issues and concerns regarding the application of LAN technology to either of these objectives are discussed. Additionally, the application of digital switching technology, specifically, use of the Integrated Multiplex, Patch, and Test (IMPAT) equipment, has also been considered as a means to fulfill these intercommunication requirements. GRA

N86-26516# M/A-COM Linkabit, Inc., Vienna, Va.
COMMERCIAL SATCOM SUBARCHITECTURE ASSESSMENTS AND INITIAL CONCEPTS Final Report, 17 Jun. - 22 Nov. 1985
Kamal Chahine 22 Nov. 1985 75 p
(AD-A165549; Rept-166) Avail: NTIS HC A04/MF A01 CSCL 17/2

This document reviews existing and planned, domestic and international commercial SATCOM assets for each of the following 3 time frames: Current (1985), mid-term (1986 to 1991) and far-term (1992 to 2000). In addition, current DOD use of these assets is summarized and assessed. Summary descriptions of some major mid-term DOD systems, networks and architectures are given. Alternative far-term concepts for the use of commercial SATCOM as a complement to MILSATs in providing additional service and robust connectivity are also presented. GRA

N86-26517# Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
METHODS OF OBTAINING OFFSHORE WIND DIRECTION AND SEA-STATE DATA FROM X-BAND AIRCRAFT SAR (SYNTHETIC APERTURE RADAR) IMAGERY OF COASTAL WATERS
Gary A. Mastin, Charles A. Harlow, Oscar K. Huh, and S. A. Hsu Apr. 1985 18 p
(Contract N00014-83-C-0150)
(AD-A165552; TR-410) Avail: NTIS HC A02/MF A01 CSCL 17/9

X-band synthetic aperture radar (SAR) imagery of the Goto Islands of Japan was digitally analyzed to extract air-sea interaction parameters and to assess the potential of texture measures in analysis of SAR ocean imagery. Wind direction is extracted from wind rows, wind streaks, and random turbulence patterns observed in the SAR imagery. Sea-state parameters are either extracted directly from the imagery or estimated using the extracted information in previously established empirical formulas. A convenient method of digitally presenting imagery, local power spectra, and the extracted/estimated parameters is presented. Texture analysis based on gray-level co-occurrence (GLC) matrices is applied to SAR ocean imagery. The inertia measure is shown to extract similar information to the power spectrum. The cluster-shade measure is shown to be sensitive to image phase. GRA

N86-26518# Stuttgart Univ. (West Germany). Inst. for Navigation.
SYNTHETIC APERTURE RADAR (SAR) PRODUCT SIMULATION Final Report
G. Domik (Technische Univ., Graz, Austria), Ph. Hartl, A. Popella (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart, West Germany), and A. J. Sieber Paris ESA Jul. 1985 241 p
(ESA-CR(P)-2149; ESA-86-96876) Avail: NTIS HC A11/MF A01

Existing SAR product simulator applicability to advanced land missions was assessed. It is found that none of them are appropriate. The requested input files characterizing the topography of an area of interest are not available to the quality necessary for realistic simulations. As part of the simulation process itself, the modeling of image speckle and image texture and the coherent SAR data hologram need more research. The development of a coherent radar cross section data base, including coordinated monostatic and bistatic calibrated measurements; development of algorithms for modeling image speckle and image texture, and

verification by analysis of existing SAR data; and harmonization of the development of digital terrain models are recommended. ESA

N86-26519# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abt. Hochfrequenzverfahren.
STATISTICAL ANALYSIS OF DIGITAL SIDE-LOOKING AIRBORNE RADAR (SLAR) DATA
Juergen Nithack Aug. 1985 54 p
(DFVLR-FB-85-59; ISSN-0171-1342; ESA-86-96879) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 18

Statistical characteristics of X-Band radar data taken with digital SLAR were analyzed. It is shown that gray value distributions of range strips (50 pixels wide) and of distributed targets are sufficiently described by a normal distribution. Errors of 1st and 2nd kind were evaluated to judge the possibilities of classification, to define the minimum characteristic area of a surface type, and to judge internal equality of different surface types and equality of surface data over range after radiometric correction. A method to derive a correction factor from the SLAR data is demonstrated. This factor comprises system characteristics and geometry parameters only. A calibration concept is described, and requirements concerning calibration normals and overall accuracy are derived from the results of the data analysis. ESA

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N86-26520*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INDIUM PHOSPHIDE SOLAR CELLS: STATUS AND PROSPECTS FOR USE IN SPACE
Irving Weinberg and David J. Brinker 1986 11 p Presented at 21st Intersociety Energy Conversion Engineering Conference (IECEC), San Diego, Calif. 25-29 Aug. 1986; sponsored by American Ceramic Society, SAE, American Nuclear Society, IEEE, AIAA and American Institute of Chemical Engineers
(NASA-TM-87315; E-3046; NAS 1.15:87315) Avail: NTIS HC A02/MF A01 CSCL 10A

The current status of indium phosphide cell research is reviewed and state of the art efficiencies compared to those of GaAs and Si. It is shown that the radiation resistance of InP cells is superior to that of either GaAs or Si under 1 MeV electron and 10 MeV proton irradiation. Using lightweight blanket technology, a SEP array structure and projected cell efficiencies, array specific powers are obtained for all three cell types. Array performance is calculated as a function of time in orbit. The results indicate that arrays using InP cells can outperform those using GaAs or Si in orbits where radiation is a significant cell degradation factor. It is concluded that InP solar cells are excellent prospects for future use in the space radiation environment. Author

N86-26521# California Univ., Berkeley. Lawrence Berkeley Lab.
OPTICAL AND ELECTROCHEMICAL STUDY OF MODEL ZINC ELECTRODE PORES IN ALKALINE ELECTROLYTE
J. H. Flatt, F. R. McLarnon, and E. J. Cairns Sep. 1985 179 p
(Contract DE-AC03-76SF-00098)
(DE86-002967; LBL-20025) Avail: NTIS HC A09/MF A01

A computer-controlled model single-pore cell has been developed to study zinc electrode discharge behavior in alkaline electrolytes. The cell design allows for simultaneous microscopic and potential performance observations. A quartz-supported, thin-film cadmium reference microelectrode was designed, fabricated and installed in the cell. The cell was designed to create model pores of dimensions comparable to those in commercial zinc electrodes. Zinc electrode discharge behavior was studied in pores of effective radii between 14 and 20 microns at 7 mA/sq cm, 30 mA/sq cm and 1250 mA/sq cm rates of discharge in 7.7M KOH electrolyte. Results are consistent with a dissolution-precipitation discharge reaction mechanism. SEM studies showed significant variations in electrodes surface morphology with location in the pore and rate of discharge. Significant pore[OH(-)] gradients, with slow relaxation times, were found to exist within the pore at the mA/sq cm rate. Passivation was observed at the 1250 mA/sq cm rate. Zinc electrode discharge behavior in 3.5M KOH-3.4M KF showed a similar discharge reaction mechanism. However, earlier surface film formation in 3.5M KOH-3.4M KF was found to occur. Initial reaction penetration depths in 7.7M KOH and 3.5M KOH-3.4M KF electrolytes were 0.11 cm and 0.10 cm. DOE

N86-26522# Naval Research Lab., Washington, D. C.
ANALYSIS OF HELICAL WAVEGUIDE
S. Ahn and A. K. Ganguly 23 Dec. 1985 32 p
(AD-A163252; NRL-MR-5620) Avail: NTIS HC A03/MF A01 CSCL 09/1

The dispersion characteristics of the large diameter helical waveguide are calculated using Pierce's small signal theory. The backward wave oscillation poses a serious problem for the development of this circuit as a broad-band, high gain amplifier. The gain of the backward waves is in general higher than the gain of the forward waves. For the first space harmonic (m=1) mode, the forward and the backward wave gains are, respectively, 2.17 dB/cm and 2.24 dB.cm. The bandwidth is 40% for a total gain of 30 dB if the backward waves are ignored. The onset of the backward wave oscillation limits the bandwidth to 5% for such high gain. The threshold interaction length for the onset of oscillation is also calculated. If the oscillations are not suppressed, the total gain of the circuit is limited to about 12 dB. At this low gain, the bandwidth can be as high as 57%. The device performs better with the low order space harmonic modes. Not only the gain and the bandwidth are larger for the low order modes but the ratio of the backward to forward wave gains and the number of the backward waves excited are also smaller. Author (GRA)

N86-26523# Oregon Graduate Center for Study and Research, Beaverton.
MONOLITHIC CATHODES Final Report, Dec. 1983 - Apr. 1985
Paul R. Davis and Lynwood W. Swanson Nov. 1985 33 p
(Contract F19628-84-K-0026)
(AD-A163282; RADC-TR-85-211) Avail: NTIS HC A03/MF A01 CSCL 09/1

The purpose of this program was to evaluate LaB6 (210) and (310) oriented single crystal material for flat cathode applications and to deliver mounted LaB6 cathodes with (310) orientation for operation in RADC/Varian life test vehicles. To that end, the program was divided into four separate tasks, as shown in the report. This project was extended for 3 months past the initial program period so that unavoidable delays could be overcome and the project completed. The final report covers the entire period of the program, which terminated 29 March 1985. GRA

N86-26524# Dayton Univ., Ohio. School of Engineering.
NON-UNIFORM CURRENTS ON A WEDGE ILLUMINATED BY A TE (TRANSVERSE ELECTRIC) PLANE WAVE Interim Report, Sep. 1984 - Jul. 1985
P. K. Murthy and Gary A. Thiele Nov. 1985 44 p
(Contract F19628-83-K-0034)
(AD-A163323; UDR-TR-85-84; RADC-TR-85-212) Avail: NTIS HC A03/MF A01 CSCL 20/3

Closed form expressions for nonuniform currents on a perfectly conducting, infinite wedge illuminated by transverse electric plane wave are presented. These expressions are derived by requiring that they coincide with the current predicted by the asymptotic diffraction theory far from the edge and, further, that they agree with the current predicted by the eigenfunction solution at the edge. The angle of incidence is arbitrary and our expressions remain valid even for glancing angles of incidence when either

one or both faces of the wedge is in the vicinity of a geometric optic boundary. Formulas presented here are simple involving the well known modified Fresnel functions but are not uniform. Exact expressions for non-uniform currents are available for the two special cases of half plane and infinite plane. For these special cases, our solution reduces to the exact solution. Currents computed using the expressions developed here are compared with currents computed from the eigenfunction solution of the wedge. Good agreement is obtained throughout. Author (GRA)

N86-26525# Utah Univ., Salt Lake City. Dept. of Electrical Engineering.
A THREE DIMENSIONAL PLASMA SIMULATION CODE APPLIED TO PHASE VELOCITY PREDICTION IN A COUPLED CAVITY CIRCUIT Final Technical Report, Sep. 1982 - Sep. 1985
Paul E. Prince Oct. 1985 54 p
(Contract F30602-82-C-0161)
(AD-A163331; UTEC-85-049; RADC-TR-85-198) Avail: NTIS HC A04/MF A01 CSCL 20/3

The problems encountered in the design of circuits for traveling wave devices are of sufficient difficulty that analytic solutions are not usually possible. Historically, resistive networks, electrolytic tanks, and analog computers have been used to simulate devices and thereby permit direct measurement of the field variations. With the advent of large digital computers, it has become possible to solve these problems in a much more general fashion by numerically integrating the fundamental differential equations over a discrete mesh. The recent development of numerical techniques to efficiently handle the massive data storage problem necessary to self-consistently solve Maxwell's equations with sources, combined with the continuing improvement in computer price/performance ratios, has led to the development of computer codes powerful enough to perform three-dimensional numerical experiments. Codes of this type have been used for a number of years in EMP calculations and in plasma physics. This paper will present the initial results of applying a three-dimensional plasma simulation code to microwave tube design problems; specifically, the cold testing of coupled-cavity to find phase/frequency characteristics. GRA

N86-26526# Aerospace Corp., El Segundo, Calif. Chemistry and Physics Lab.
EVALUATION OF TWT (TRAVELING WAVE TUBE) CATHODE IMPREGNANT MANUFACTURING PROCEDURES
R. A. Lipeles 27 Nov. 1985 27 p
(Contract F04701-85-C-0086)
(AD-A163360; TR-0086(6945-02)-1; SD-TR-85-84) Avail: NTIS HC A03/MF A01 CSCL 09/1

Impregnant manufacturing procedures were evaluated as part of a program to develop guidelines for producing reliable dispenser cathodes. Such procedures must be controlled in order to eliminate variations in impregnant composition that can give rise to unpredictable cathode performance. Experiments revealed that variations in impregnant composition result primarily from contamination by moisture, incomplete mixing, and incomplete reaction. Procedures developed to overcome these problems are discussed. The following recommendations are made: (1) Alumina must be dried prior to weighing to avoid inaccurate formulation due to moisture. (2) Multiple dry and wet mixing steps are nedded to thoroughly homogenize the starting materials. (3) Calcination temperatures of 1300 + or - 60 C are required to form thoroughly reacted barium calcium aluminates. (4) Thermogravimetry is useful for testing impregnants and starting materials for moisture contamination. GRA

N86-26527# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Sci.
COMPACTION WITH AUTOMATIC JOG INTRODUCTION
F. M. Maley Oct. 1985 24 p refs
(Contract N00014-80-C-0622)
(AD-A163436) Avail: NTIS HC A02/MF A01 CSCL 09/5

A novel polynomial-time algorithm for compacting a VLSI layout is presented. Compared to previous algorithms, the algorithm promises to produce higher quality output while reducing the need for designer intervention. The performance gain is realized by converting wires into constraints on the positions of the active devices. These constraints can be solved by graph-theoretic techniques to yield optimal positions for chip components. A single-layer router is then used to restore the wires to the layout, using as many as jogs as necessary. An automated compaction procedure is an effective tool for cutting production costs of a VLSI circuit at low cost to the designer, because the yield of fabricated chips is strongly dependent on the total circuit area. Sect 1 is an introduction. Sect 2 states the definitions and theoretical results that underlie the new compaction method. Sect 3 shows how the circuit layout is converted to a data structure appropriate for compaction, and Sect 4 details the body of the compaction algorithm. Sect 5 covers several improvements to the algorithm that should make it run considerably faster. Sect 6 comments on the algorithms of results, and a discussion of the practical value of the compaction algorithm. GRA

N86-26528# Department of the Army, Washington, D. C.
AMORPHOUS SILICON SPATIAL LIGHT MODULATOR Patent Application
Paul R. Ashley, inventor (to Army) Filed 23 Dec. 1985 9 p
(AD-D012168; US-Patent-Appl-SN-812603) Avail: NTIS HC A02/MF A01 CSCL 09/3

This patent application discloses an amorphous silicon spatial light modulator that includes a unique three electrode structure that is used to create a two-dimensional electric field distribution in liquid crystal material. This modulator allows for the use of very thin photoconductor layers and a middle electrode in the form of a grating structure to provide control of the field shape while also providing for high spatial resolution. GRA

N86-26529# Department of the Air Force, Washington, D.C.
POWER SENSING DEVICE Patent Application
Jaime Quiros, inventor (to Air Force) Filed 19 Jul. 1985 12 p
(AD-D012171; US-Patent-Appl-SN-756549) Avail: NTIS HC A02/MF A01 CSCL 09/5

A power sensing device is disclosed for use with an electrical alternating current (AC) power source, a primary load, and a plurality of secondary loads. The power sensing device detects when the primary load is turned on, and automatically supplies power from the electrical AC power source to the plurality of secondary loads in response thereto. The power sensing device also senses when the primary load is turned off, and removes electrical power from the plurality of secondary loads in response thereto. Author (GRA)

N86-26530# Rome Air Development Center, Griffiss AFB, N.Y.
MINIMIZING EHF WAVEGUIDE LOSSES
Edward W. Gilbertson Dec. 1985 79 p
(AD-A164726; RADC-TR-85-223) Avail: NTIS HC A05/MF A01 CSCL 09/1

To minimize RF power transmission losses at high frequencies, rectangualr waveguide has become the standard transmission medium. At EHF frequencies, rectangular waveguide attenuation rises to unacceptably high levels. To minimize waveguide loss, length is minimized. Where this is not possible, a variety of alternatives exist, each having lower attenuation than standard rectangular waveguide and each with its own advantages and limitations. Square circular (modes TE11 and TE01), oversized rectangular, oversized circular (modes TE11 and TE01), and dielectric waveguides are addressed and categorized according to bendability. By choosing the technology with the lowest attenuation which meets the installation's bendability requirements, the optimum transmision method can be determined. Attenuations are calculated for comparison at 44 GHz, but the discussion is general enough to hold throughout the EHF frequency range.GRA

N86-26531# Princeton Univ., N. J. Information Sciences and Systems Lab.
FINITE LENGTH DISCRETE MATCHED FILTERS
Andrew B. Martinez and John B. Thomas Jan. 1986 18 p

(Contract N00014-81-K-0146)
(AD-A164869; TR-20) Avail: NTIS HC A02/MF A01 CSCL 09/5

The Matched Filter (MF) is well known to be the linear detector that has the maximum output Signal-to-Noise Ratio (SNR). The problem of finding the minimum filter length in discrete time to achieve a certain level of performance is considered when there is some freedom in choosing a signal shape. Upper and lower bounds on the SNR are given in terms of the eigenvalues of the noise covariance matrix. Since these bounds are rather difficult to compute, looser, but easier to compute, bounds are given. Several examples are presented which illustrate the exact and approximate bounds. GRA

N86-26532# Ohio State Univ., Columbus. ElectroScience Lab.
JOINT SERVICES ELECTRONICS PROGRAM Annual Report, Oct. 1984 - Sep. 1985
Dec. 1985 187 p refs
(Contract N00014-78-C-0049)
(AD-A164916; ESL-710816-18; AR-8) Avail: NTIS HC A09/MF A01 CSCL 09/5

An overview of the research in electromagnetics is given. The progress in diffraction studies, which include diffraction by nonconducting surfaces, vertex diffraction, diffraction by wedges, diffraction in the paraxial regions of smooth quasicylindrical convex surfaces, and caustic field analysis, is reviewed. Hybrid techniques including diffraction by perfectly conducting surfaces, the problem of diffraction by edges formed at junctions between perfectly conducting and dielectric boundaries, analysis of microstrip antennas, and reflecting antenna synthesis are presented. Integral equation studies of material coated edges and time domain studies are also updated. E.R.

N86-26533# Illinois Univ., Urbana. Coordinated Science Lab.
QUASI-TEM ANALYSIS OF MICROWAVE TRANSMISSION LINES BY THE FINITE ELEMENT METHOD
Zorica Pantic and Raj Mittra Feb. 1986 35 p
(Contract N00014-84-C-0149)
(AD-A164943; UILU-ENG-86-2205) Avail: NTIS HC A03/MF A01 CSCL 09/3

This paper describes a finite element approach to quasi-TEM analysis of several different types of isolated and coupled microwace transmission lines. Both the first and higher-order ordinary elements, as well as singular and infinite elements are used to solve for the potential and field distribution in the cross-section of the line. Next, the cross-sectional field distribution is inserted in a variational expression to compute the capacitance per unit length of the line and the effective permittivity and characteristic impedance of the line are obtained from the capacitance value. A perturbationl approach is developed for estimating the losses due to conductor and dielectric dissipation and computing the attentuation constant. Lines treatable by this method may contain an arbitrary number of arbitrarily shaped conductors, including a system of conductors either placed above a single ground plane or between two parallel ground planes, and inhomogeneous dielectric regions that can be approximated locally by a number of homogeneous subregions. GRA

N86-26534# Naval Postgraduate School, Monterey, Calif.
DIGITALLY CONTROLLED PROGRAMMABLE ACTIVE FILTERS M.S. Thesis
Panagiotis Andresakis Dec. 1985 201 p refs
(AD-A164999) Avail: NTIS HC A10/MF A01 CSCL 09/3

In this research a general purpose digitally controlled analog filter is presented. The novel design is a cascade of second order sections that are individually programmed to achieve any filtering topologies. Two binary words are used to control the pole frequency omega p and selectivity Qp of each section independently. Each second order section is a Generalized-Immittance Converter (GIC) biquads which are known for their high stability and low active and passive sensitivity. CMOS switches are used to electronically relocate the minimum number of passive elements to achieve function programmability. Switches are also used to select the number of cascaded sections to realize higher order transfer functions. GRA

N86-26535# Rome Air Development Center, Griffiss AFB, N.Y.
CONCEPT STUDY OF A MULTIPLE BEAM LENS ANTENNA WITH AN INTERNAL PHASE SHIFT MASK
Daniel T. McGrath Aug. 1985 28 p
(AD-A165277; RADC-TR-85-159) Avail: NTIS HC A03/MF A01 CSCL 09/5

A new antenna architecture has been investigated to assess its usefulness for limited scan systems. It consists of a passive lens with a few small subarrays spaced evenly across its focal surface. Between the lens and the focal surface is a phase shift layer, or mask, comprised of oppositely-facing planar arrays interconnected by phase shifters (similiar to a phased array lens). The mask redirects a focusing wave from an arbitrary angle onto one of the subarrays. It is shown that a system with only 19 small subarrays, and a mask containing about 4500 elements could provide complete Earth coverage with as many as 19 simultaneous 0.3 deg beams. The pattern quality of those beams is good, provided that no two are steered to within a few beamwidths of each other. GRA

N86-26536# Polytechnic Inst. of New York, Brooklyn.
LUMPED-ELEMENT AND LEAKY-WAVE ANTENNAS FOR MILLIMETER WAVES Final Technical Report
A. A. Oliner Jan. 1986 193 p
(Contract F19628-81-K-0044)
(AD-A165280; RADC-TR-85-255) Avail: NTIS HC A09/MF A01 CSCL 09/5

This contract was concerned with millimeter wave antennas that cannot be scaled from their microwave frequency counterparts, and it concentrated on novel leaky wave antennas. Two such waveguides were selected: the groove guide, and nonradiative dielectric (NRD) guide. Six different leaky wave antennas were analyzed on this program, with two treated in special detail. Three different mechanisms for producing leakage were employed: asymmetry, foreshortening the structure's cross section, and using leaky higher modes. The different mechanisms also lead to different polarizations of the radiated fields. Accurate theoretical analyses were conducted for each of the antenna structures. Transverse equivalent networks were established, the elements of which were derived in closed form, so that the dispersion relations were also. Numerical values for the propagation characteristics were obtained as a function of various geometric parameters, to aid in the design of antennas based on these leaky structures. Special design considerations, including optimization procedures, were also developed when possible. GRA

N86-26537# Massachusetts Univ., Amherst. Dept. of Electrical and Computer Engineering.
ANALYSIS OF AN APERTURE COUPLED MICROSTRIP ANTENNA Interim Report, Jan. 1984 - Jul. 1985
Peter L. Sullivan and Daniel H. Schaubert Feb. 1986 68 p
(Contract F19628-84-K-0022)
(AD-A165283; RADC-TR-85-274) Avail: NTIS HC A04/MF A01 CSCL 09/5

A new feed configuration for microstrip antennas is analyzed. The antenna consists of a single rectangular microstrip patch coupled through a rectangular aperture to a microstrip line on a separate substrate. The report describes the theory which uses a moment method analysis to calculate the antenna's input impedance. The analysis was verified by comparison with measurements of patch antennas on a low-dielectric-constant substrate (2.54) and the feed line on high-dielectric-constant (10.2) substrate.
Author (GRA)

N86-26538# Systems Science and Software, La Jolla, Calif.
IONIZATION INDUCED INSTABILITY IN AN ELECTRON COLLECTING SHEATH
D. L. Cooke and I. Katz Jun. 1985 30 p
(Contract F19628-82-C-0081)
(AD-A165330; SSS-R-85-7343; AFGL-TR-85-0256; SR-2) Avail:

NTIS HC A03/MF A01 CSCL 09/1

A numerical investigation of the electron collecting sheath about a positively biased probe in the ionosphere has been conducted to determine the effect of ionization within the sheath. This report is directed at the space charge limited regime appropriate to objects with characteristic size much larger than the ambient Debye length, and uniform surface potential much greater than the ambient plasma temperature. A fluid approximation is employed to model the dynamics of the secondary plasma produced within the sheath. The results indicate that when the secondary ion production exceeds a critical level, the sheath edge propagates outward in an explosive fashion, in a manner similar to the propagation of double layers. This critical level is shown to be equivalent to a mean free path for ionization by electrons lambda sub ie < (sq. rt. (m(sub i)/m(sub e))) (D(sub S)/alpha) where D sub S is the sheath thickness and alpha is a geometry dependent parameter. Usual ionosphere-probe interactions appear to be sub critical, but an enhanced neutral background might be produced by shuttle contaminants, could reach the critical level, and trigger the instability. GRA

N86-26539# Naval Postgraduate School, Monterey, Calif.
ELECTRON INDUCED CONDUCTIVITY OF AL2O3 AS PERTAINING TO THERMIONIC INTEGRATED CIRCUITS M.S. Thesis
Peter J. Peterson Dec. 1985 109 p
(AD-A165589) Avail: NTIS HC A06/MF A01 CSCL 09/5

Experiments were conducted to measure the electron induced conductivity (EIC) of single crystal sapphire (Al2O3) and polycrystalline alumina (Al2O3). The EIC is generated when the samples are bombarded with high energy electrons, utilizing the Naval Postgraduate School's S-band linear accelerator (LINAC). The EIC was measured at dose rate up to 6 x 10 to the 7th power rad (Si)/sec. The EIC for alumina was an order of magnitude smaller than the value for sapphire. The value calculated for alumina was 10,000 per ohm cm and 1,000 per ohm cm for sapphire. The response of EIC to a given dose rate did not change as the dose accumulated. Surface flashover problems during electron irradiation were observed and are discussed. GRA

N86-26540# Department of the Navy, Washington, D. C.
SELF ALIGNED NOTCH FOR InP PLANAR TRANSFERRED ELECTRON OSCILLATOR Patent Application
Steven C. Binari, inventor (to Navy) Filed 13 Jan. 1986 14 p
(AD-D012185; US-Patent-Appl-SN-818512) Avail: NTIS HC A02/MF A01 CSCL 09/5

A method of fabricating a notched indium phosphide planar transferred electron oscillator device which automatically aligns the high-resistivity notch position immediately adjacent to the cathode contact by slant evaporation of a metal coating over the edge of a masking layer followed by ion implantation. GRA

N86-26541# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science/ Algorithmics and Archite.
AREA PENALTY FOR SUBLINEAR SIGNAL PROPAGATION DELAY ON CHIP (PRELIMINARY VERSION)
Paul M. B. Vitanyi Aug. 1985 25 p Partly in ENGLISH and FRENCH Presented at 26th Annual IEEE Symposium on Foundations of Computer Science, Portland, Oreg., 21-23 Oct. 1985 Revised
(Contract BMFT-0101-ZA/WF/WRD-174/4)
(CWI-CS-R8514; B8575491; ESA-86-97005) Avail: NTIS HC A02/MF A01

It is shown that sublinear signal propagation delay in VLSI circuits carries a far greater penalty in wire area than is commonly realized. Therefore, the global complexity of VLSI circuits is more layout dependent than thought. This effect is pronounced in wafer scale integration technology. Lower bounds on the trade-off between sublinear signaling speed and layout area for the implementation of a complete binary tree in VLSI are established. Sublinear delay can only be realized at the cost of superlinear area. Designs with equal length wires can either not be laid out at all (for logarithmic delay) or require such long wires in the case of radical delay that the aimed for gain in speed is cancelled. For wire length distributions commonly occurring on chip, the requirements for sublinear signal propagation delay tend to cancel the gain. ESA

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N86-26542 Royal Aircraft Establishment, Farnborough (England). Inst. of Sound and Vibration Research.
THE AIR-INJECTION METHOD OF FIXING BOUNDARY-LAYER TRANSITION AND INVESTIGATING SCALE EFFECTS
P. R. Ashill, comp., J. L. Fulker, comp., D. J. Weeks, and M. Verain 15 Mar. 1985 44 p refs
(RAE-TR-85025; RAE-AERO-3609; BR97257; ESA-85-96844)
Copyright. Avail: Issuing Activity

Experience with the air-injection method of fixing transition in wind tunnel tests on two-dimensional airfoils and a swept panel at high subsonic free-stream speeds is described. The method is shown to provide a repeatable level of disturbance which, for a given flow condition, may be generated without interrupting the test, and does not cause a significant excess drag. Examples illustrate the effectiveness of the technique in demonstrating scale-sensitive features of flows. A correlation which allows the minimum value of air-injection mass flow needed to fix transition to be estimated from a knowledge of the behavior of natural laminar flow on the wing is presented. ESA

N86-26543*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON THE EXISTENCE OF SOLUTIONS OF AN EQUATION ARISING IN THE THEORY OF LAMINAR FLOW IN A UNIFORMLY POROUS CHANNEL WITH INJECTION Final Report
Ke-Gang Shih Mar. 1986 27 p refs Sponsored by NASA. Langley Research Center, Hampton, Va. Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178078; ICASE-86-17; NAS 1.26:178078) Avail: NTIS HC A03/MF A01 CSCL 20D

The existence of concave solutions of Berman's equation which describes the laminar flow in channels with injection through porous walls is established. It was found that the (unique) concave solutions exist for all injection Reynolds number R < 0. Author

N86-26544*# Universities Space Research Association, Huntsville, Ala. Science and Engineering Directorate.
A COMPUTER CODE FOR THREE-DIMENSIONAL INCOMPRESSIBLE FLOWS USING NONORTHOGONAL BODY-FITTED COORDINATE SYSTEMS Final Report
Y. S. Chen Mar. 1986 86 p refs
(Contract NAS8-35918)
(NASA-CR-178818; NAS 1.26:178818) Avail: NTIS HC A05/MF A01 CSCL 20D

In this report, a numerical method for solving the equations of motion of three-dimensional incompressible flows in nonorthogonal body-fitted coordinate (BFC) systems has been developed. The equations of motion are transformed to a generalized curvilinear coordinate system from which the transformed equations are discretized using finite difference approximations in the transformed domain. The hybrid scheme is used to approximate the convection terms in the governing equations. Solutions of the finite difference equations are obtained iteratively by using a pressure-velocity correction algorithm (SIMPLE-C). Numerical examples of two- and three-dimensional, laminar and turbulent flow problems are employed to evaluate the accuracy and efficiency of the present computer code. The user's guide and computer program listing of the present code are also included. Author

N86-26545*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATION OF A COMPUTATIONAL MODEL FOR VORTEX GENERATORS IN SUBSONIC INTERNAL FLOWS
William G. Kunik 1986 24 p refs Presented at the 22nd Joint Propulsion Conference, Huntsville, Ala., 16-18 Jun. 1986; sponsored by AIAA, ASME, SAE and ASEE
(NASA-TM-87327; E-3072; NAS 1.15:87327; AIAA-86-1458) Avail: NTIS HC A02/MF A01 CSCL 20D

A model for the analysis of vortex generators in a fully viscous subsonic internal flow is evaluated. A vorticity source term is used in a modified form of the Parabolized Navier-Stokes equations to model the shed vortex. Computed results are compared with idealized flow vortex paths, and with experimental data for vortex generators embedded in a thick turbulent boundary layer. The analysis is also compared with experimental data for a separated diffusing S-duct and for a diffusing S-duct with vortex generators. Quantitative comparisons are shown for the latter three cases. Emphasis is placed on verifying the ability of the model to predict global distortions in the flow field. Author

N86-26546*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.
THERMODYNAMIC EVALUATION OF TRANSONIC COMPRESSOR ROTORS USING THE FINITE VOLUME APPROACH Semiannual Status Report, 20 Dec. 1985 - 31 May 1986
Stephen Nicholson and John Moore 1986 81 p
(Grant NAG3-593)
(NASA-CR-176840; NAS 1.26:176840; JM/86-2) Avail: NTIS HC A05/MF A01 CSCL 20D

The finite volume explicit time marching method was refined and improved. Previously, extension had been made to the finite volume method to improve the accuracy of the calculation of total pressure in inviscid flow, extend the method to allow the calculation of laminar and turbulent boundary layers in internal flows, and improve the shock capturing properties of the method by introducing a Mach number dependent interpolation scheme for the pressure used in the calculating the density. The current work extends these developments by using the new pressure interpolation scheme in two dimensional viscous calculations, including a more complete description of the viscous stresses, introducing a criteria for the transverse upwind differencing which is a function of the ratio of transverse and streamwise mass fluxes, and allowing the calculation of internal flow where boundary layers are present on both walls of the duct. The manner in which the viscous stresses are evaluated in the nonorthogonal, nonuniform grid is detailed. The convergence is investigated and results for calculations of laminar flow in a converging duct are presented. Results for calculations of transonic flow in a converging-diverging nozzle are presented and the results are compared with Sajben's measurements and calculations by others. Author

N86-26547*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MULTIGRID METHOD FOR A VORTEX BREAKDOWN SIMULATION
Shlomo Taasan May 1986 23 p refs
(Contracts NAS1-17070; NAS1-18107)
(NASA-CR-178106; ICASE-86-29; NAS 1.26:178106) Avail: NTIS HC A02/MF A01 CSCL 20D

An inviscid model for a steady axisymmetric flow with swirl was studied. The governing equation is a nonlinear elliptic equation which has more than one solution for a certain range of the swirl parameter. The physically interesting solutions have closed streamlines that look like vortex breakdown (bubble-like solutions). A multigrid method is used to find these solutions. Using an FMG algorithm (nested iteration), the problem is solved in just a few multigrid cycles. Author

N86-26548*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON SIMILARITY SOLUTIONS OF A BOUNDARY LAYER PROBLEM WITH AN UPSTREAM MOVING WALL
M. Y. Hussaini, W. D. Lakin (Old Dominion Univ., Norfolk, Va.), and A. Nachman (Air Force Office of Scientific Research, Bolling AFB, Washington, D.C.) May 1986 26 p refs
(Contracts NAS1-17070; NAS1-18107)
(NASA-CR-178104; ICASE-86-26; NAS 1.26:178104) Avail: NTIS HC A03/MF A01 CSCL 20D

The problem of a boundary layer on a flat plate which has a constant velocity opposite in direction to that of the uniform mainstream is examined. It was previously shown that the solution of this boundary value problem is crucially dependent on the parameter which is the ratio of the velocity of the plate to the velocity of the free stream. In particular, it was proved that a solution exists only if this parameter does not exceed a certain critical value, and numerical evidence was adduced to show that this solution is nonunique. Using Crocco formulation the present work proves this nonuniqueness. Also considered are the analyticity of solutions and the derivation of upper bounds on the critical value of wall velocity parameter. Author

N86-26549*# National Aeronautics and Space Administration, Washington, D.C.
SELF-ADAPTIVE DIFFERENCE METHOD FOR THE EFFECTIVE SOLUTION OF COMPUTATIONALLY COMPLEX PROBLEMS OF BOUNDARY LAYER THEORY
W. Schoenauer, H.-G. Daeubler, G. Glotz, and J. Gruening Jun. 1986 25 p refs Transl. into ENGLISH of conf. paper "Selbsttsteuernde Differenzenverfahren zur Effektiven Loesung von Stark Rechenintensiven Problemen der Grenzschichttheorie" presented at DGLR 9th Annual Convention, 1976 p 1-20 Conference held in Munich, West Germany, 14-16 Sep. 1976 Original language document was announced in IAA as A77-16564 Transl. by The Corporate Word, Inc., Pittsburgh, Pa. Original doc. prep. by Karlsruhe Univ.
(Contract NASw-4006)
(NASA-TM-88440; NAS 1.15:88440; DGLR-76-185) Avail: NTIS HC A02/MF A01 CSCL 20D

An implicit difference procedure for the solution of equations for a chemically reacting hypersonic boundary layer is described. Difference forms of arbitrary error order in the x and y coordinate plane were used to derive estimates for discretization error. Computational complexity and time were minimized by the use of this difference method and the iteration of the nonlinear boundary layer equations was regulated by discretization error. Velocity and temperature profiles are presented for Mach 20.14 and Mach 18.5; variables are velocity profiles, temperature profiles, mass flow factor, Stanton number, and friction drag coefficient; three figures include numeric data. B.J.

N86-26550*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SPECTRAL METHODS IN FLUID DYNAMICS Final Report
M. Y. Hussaini and T. A. Zang May 1986 63 p refs Sponsored by NASA. Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178103; ICASE-86-25; NAS 1.26:178103) Avail: NTIS HC A04/MF A01 CSCL 20D

Fundamental aspects of spectral methods are introduced. Recent developments in spectral methods are reviewed with an emphasis on collocation techniques. Their applications to both compressible and incompressible flows, to viscous as well as inviscid flows, and also to chemically reacting flows are surveyed. The key role that these methods play in the simulation of stability, transition, and turbulence is brought out. A perspective is provided on some of the obstacles that prohibit a wider use of these methods, and how these obstacles are being overcome. Author

N86-26551*# Alabama Univ., Huntsville.
MONOBALL ENERGY TRANSFER: TEST REPORT Final Report, 27 Sep. 1985 - 26 Jun. 1986
Francis C. Wessling Jun. 1986 23 p
(Grant NAG8-046)
(NASA-CR-176812; NAS 1.26:176812) Avail: NTIS HC A02/MF A01 CSCL 20D

An aluminum platform serves as a storage shelf for experiments transported on the space shuttle. This platform is attached to the shuttle storage area through several supports, each consisting of an attachment fitting, a monoball bearing, a clevis pin and a support strut. The experiments must be temperature controlled during and after launch. Consequently, heat loss through the plate, attachment fitting, monoball bearing, and strut are important. The overall conductance of the monoball bearing was determined by an experimental method of heating the outer ring with a nichrome resistance wire and cooling the inner ball with propylene glycol. Temperature differences across the bearing were measured for various heat fluxes. The overall conductance is 0.42 Watts/C (0.80 BTU/hr F), This yields a 16 watt loss for a 38 C temperature difference across the bearing. Author

N86-26552*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ADVANCES IN NUMERICAL AND APPLIED MATHEMATICS Final Report
J. C. South, Jr., ed. and M. Y. Hussaini, ed. Mar. 1986 593 p Submitted for publication
(Contracts NAS1-17070; NAS1-18107)
(NASA-CR-178076; ICASE-86-18; NAS 1.26:178076) Avail: NTIS HC A25/MF A01 CSCL 20D

This collection of papers covers some recent developments in numerical analysis and computational fluid dynamics. Some of these studies are of a fundamental nature. They address basic issues such as intermediate boundary conditions for approximate factorization schemes, existence and uniqueness of steady states for time dependent problems, and pitfalls of implicit time stepping. The other studies deal with modern numerical methods such as total variation diminishing schemes, higher order variants of vortex and particle methods, spectral multidomain techniques, and front tracking techniques. There is also a paper on adaptive grids. The fluid dynamics papers treat the classical problems of imcompressible flows in helically coiled pipes, vortex breakdown, and transonic flows. For individual titles, see N86-26553 through N86-26573.

N86-26553*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CONVERGENCE TO STEADY STATE OF SOLUTIONS OF BURGERS' EQUATION
Gunilla Kreiss (Royal Inst. of Tech., Stockholm, Sweden) and Heinz-Otto Kreiss (California Inst. of Tech., Pasadena) *In its* Advances in Numerical and Applied Mathematics Mar. 1986 p 1-29 (For primary document see N86-26552 17-34)
(Contracts NAS1-17070; NAS1-18107; Grant AF-AFOSR-0303-85) Avail: NTIS HC A25/MF A01 CSCL 20D

Consider the initial boundary value problem for Burgers' equation. It is shown that its solutions converge, in time, to a unique steady state. The speed of the convergence depends on the boundary conditions and can be exponentially slow. Methods to speed up the rate of convergence are also discussed. Author

N86-26554*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STABILITY ANALYSIS OF INTERMEDIATE BOUNDARY CONDITIONS IN APPROXIMATE FACTORIZATION SCHEMES
Jerry C. South, Jr., Mohamed M. Hafez (California Univ., Davis), and David Gottlieb (Brown Univ., Providence, R. I.) *In its* Advances in Numerical and Applied Mathematics Mar. 1986 p 30-55 (For primary document see N86-26552 17-34)
(Contracts NAS1-17070; NAS1-18107; Grant AF-AFOSR-0303-85) Avail: NTIS HC A25/MF A01 CSCL 20D

The role of the intermediate boundary condition in the approximate factorization 2 (AF2) scheme used by Holst for simulation of the transonic full potential equation was discussed. The treatment suggested by Holst led to a restriction on the time step and ways to overcome this restriction were suggested. The discussion is based on the theory developed by Gustafsson, Kreiss, and Sundstroem and also on the von Neumann method. Author

N86-26555*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MULTIPLE STEADY STATES FOR CHARACTERISTIC INITIAL VALUE PROBLEMS
M. D. Salas, S. Abarbanel (Tel-Aviv Univ., Israel), and David Gottlieb (Brown Univ., Providence, R. I.) *In its* Advances in Numerical and Applied Mathematics Mar. 1986 p 56-99 Previously announced as N85-14800 (For primary document see N86-26552 17-34)
(Contracts NAS1-17070; NAS1-18107; Grant AF-AFOSR-0303-85) Avail: NTIS HC A25/MF A01 CSCL 20D

The time dependent, isentropic, quasi-one-dimensional equations of gas dynamics and other model equations are considered under the constraint of characteristic boundary conditions. Analysis of the time evolution shows how different initial data may lead to different steady states and how seemingly anamolous behavior of the solution may be resolved. Numerical experimentation using time consistent explicit algorithms verifies the conclusions of the analysis. The use of implicit schemes with very large time steps leads to erroneous results. Author

N86-26556*# Tel-Aviv Univ. (Israel). School of Mathematical Sciences.
A MINIMUM ENTROPY PRINCIPLE IN THE GAS DYNAMICS EQUATIONS
Eitan Tadmor *In* NASA. Langley Research Center Advances in Numerical and Applied Mathematics Mar. 1986 p 100-118 (For primary document see N86-26552 17-34)
(Contracts NAS1-17070; DAAG29-85-K-0190; Grant NSF DMS-85-03294)
Avail: NTIS HC A25/MF A01 CSCL 20D

Let u(bar x,t) be a weak solution of the Euler equations, governing the inviscid polytropic gas dynamics; in addition, u(bar x,t) is assumed to respect the usual entropy conditions connected with the conservative Euler equations. It is shown that such entropy solutions of the gas dynamics equations satisfy a minimum entropy principle, namely, that the spatial minimum of the specific entropy is an increasing function of time. This principle equally applies to discrete approximations of the Euler equations such as the Godunov-type and Lax-Friedrichs schemes. The derivation of this minimum principle makes use of the fact that there is a family of generalized entropy functions connected with the conservative Euler equations. Author

N86-26557*# Florida State Univ., Tallahassee.
A SPECTRAL MULTIDOMAIN METHOD FOR THE SOLUTION OF HYPERBOLIC SYSTEMS
David A. Kopriva *In* NASA. Langley Research Center Advances in Numerical and Applied Mathematics Mar. 1986 p 119-164 (For primary document see N86-26552 17-34)
(Contracts NAS1-17070; NAS1-18107)
Avail: NTIS HC A25/MF A01 CSCL 20D

A multidomain Chebyshev spectral collocation method for solving hyperbolic partial differential equations was developed. Though spectral methods are global methods, an attractive idea is to break a computational domain into several subdomains, and a way to handle the interfaces is described. The multidomain approach offers advantages over the use of a single Chebyshev grid. It allows complex geometries to be covered, and local refinement can be used to resolve important features. For steady-state problems it reduces the stiffness associated with the use of explicit time integration as a relaxation scheme. Furthermore, the proposed method remains spectrally accurate. Results showing performance of the method on one dimensional linear models and one and two dimensional nonlinear gas dynamics problems are presented. Author

N86-26558*# Carnegie-Mellon Univ., Pittsburgh, Pa.
ON SUBSTRUCTURING ALGORITHMS AND SOLUTION TECHNIQUES FOR THE NUMERICAL APPROXIMATION OF PARTIAL DIFFERENTIAL EQUATIONS
M. D. Gunzburger and R. A. Nicolaides *In* NASA. Langley Research Center Advances in Numerical and Applied Mathematics Mar. 1986 p 165-195 (For primary document see N86-26552 17-34)

(Contracts NAS1-18107; DAAG29-83-4-0084; Grant AF-AFOSR-0231-83)
Avail: NTIS HC A25/MF A01 CSCL 20D

Substructuring methods are in common use in structural mechanics problems where typically the associated linear systems of algebraic equations are positive definite. Here these methods are extended to problems which lead to nonpositive definite, nonsymmetric matrices. The extension is based on an algorithm which carries out the block Gauss elimination procedure without the need for interchanges even when a pivot matrix is singular. Examples are provided wherein the method is used in connection with finite element solutions of the stationary Stokes equations and the Helmholtz equation, and dual methods for second-order elliptic equations. Author

N86-26559*# California Inst. of Tech., Pasadena. Dept. of Applied Mathematics.
MULTIPLE LAMINAR FLOWS THROUGH CURVED PIPES
Zhong-hua Yang and H. B. Keller *In* NASA. Langley Research Center Advances in Numerical and Applied Mathematics Mar. 1986 p 196-228 (For primary document see N86-26552 17-34)
(Contracts DE-AS03-76SF-00767; DAAG29-81-K-0107)
Avail: NTIS HC A25/MF A01 CSCL 20D

The Dean problem of steady viscous flow through a coiled circular pipe is studied numerically for a large range of Dean number and for several coiling ratios. It was found that the solution family, as parameterized by Dean number, has numerous folds or limit points. Four folds and hence five branches of solutions are found. It is speculated that infinitely many solutions can exist in this family for some fixed value(s) of D. More resolution and higher accuracy would be required to justify this conjecture and to find the rule of formation of new solution branches. Author

N86-26560*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CALCULATIONS OF THE STABILITY OF SOME AXISYMMETRIC FLOWS PROPOSED AS A MODEL OF VORTEX BREAKDOWN
Nessan Mac Giolla Mhuiris *In its* Advances in Numerical and Applied Mathematics Mar. 1986 p 229-263 (For primary document see N86-26552 17-34)
Avail: NTIS HC A25/MF A01 CSCL 20D

The term vortex breakdown refers to the abrupt and drastic changes of structure that can sometimes occur in swirling flows. It was conjectured that the bubble type of breakdown can be viewed as an axisymmetric wave traveling upstream in a primarily columnar vortex flow. In this scenario the wave's upstream progress is impeded only when it reaches a critical amplitude and it loses stability to some nonaxisymmetric disturbance. The stability of some axisymmetric wavy flows to three dimensional disturbances, viewing the amplitude of the wave as a bifurcation parameter is examined. The stability of a set of related columnar vortex flows, constructed by taking the two dimensional flow at a single axial location and extending it throughout the domain without variation, is investigated. The method used will be to expand the perturbation velocity in a series of divergence free vectors which ensures that the continuity equation for the incompressible fluid is satisfied exactly by the computed velocity field. Projections of the stability equation onto the space of inviscid vector fields eliminated the pressure term from the equation and reduces the differential eigen problem to a generalized matrix eigen problem. Results are presented both for the one dimensional, columnar vortex flows and also for the wavy bubble flow. Author

N86-26561*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NUMERICAL STUDY OF VORTEX BREAKDOWN
M. Hafez (Vigyan Research Associates, Inc., Hampton, Va.), G. Kuruvila, and M. D. Salas *In its* Advances in Numerical and Applied Mathematics Mar. 1986 p 264-290 Previously announced as A86-19948 (For primary document see N86-26552 17-34)
(Contract NAS1-17919)
Avail: NTIS HC A25/MF A01 CSCL 20D

The incompressible axisymmetric steady Navier-Stokes equations and the Euler equations are solved numerically to model the breakdown of a vortex. Although the solutions obtained for the Euler equations show a vortex breakdown-like structure, their behavior is very different from that of the Navier-Stokes equations. The details of the numerical algorithms used are presented, and the results obtained are compared to those in the literature. Author

N86-26562*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MULTIGRID METHOD FOR A VORTEX BREAKDOWN SIMULATION
Shlomo Taasan *In its* Advances in Numerical and Applied Mathematics Mar. 1986 p 291-312 (For primary document see N86-26552 17-34)
(Contracts NAS1-17070; NAS1-18107)
Avail: NTIS HC A25/MF A01 CSCL 20D

An inviscid model for a steady axisymmetric flow with swirl was studied. The governing equation is a nonlinear elliptic equation which has more than one solution for a certain range of the swirl parameter. The physically interesting solutions have closed streamlines that look like vortex breakdown (bubblelike solutions). A multigrid method is used to find these solutions. Using an FMG algorithm (nested iteration), the problem is solved in just a few multigrid cycles. Author

N86-26563*# Carnegie-Mellon Univ., Pittsburgh, Pa.
CONSTRUCTION OF HIGHER ORDER ACCURATE VORTEX AND PARTICLE METHODS
R. A. Nicolaides *In* NASA. Langley Research Center Advances in Numerical and Applied Mathematics Mar. 1986 p 312-330 (For primary document see N86-26552 17-34)
(Grant AF-AFOSR-0137-84)
Avail: NTIS HC A25/MF A01 CSCL 20D

The standard point vortex method was recently shown to be of high order of accuracy for problems on the whole plane, when using a uniform initial subdivision for assigning the vorticity to the points. If obstacles are present in the flow, this high order deteriorates to first or second order. Vortex methods which are of arbitrary accuracy (under regularity assumptions) regardless of the presence of bodies and the uniformity of the initial subdivision are introduced. Author

N86-26564*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PSEUDO-TIME ALGORITHMS FOR THE NAVIER-STOKES EQUATIONS
R. C. Swanson and E. Turkel (Tel-Aviv Univ., Isreal) *In its* Advances in Numerical and Applied Mathematics Mar. 1986 p 331-359 (For primary document see N86-26552 17-34)
(Contracts NAS1-17070; NAS1-18107)
Avail: NTIS HC A25/MF A01 CSCL 20D

A pseudo-time method is introduced to integrate the compressible Navier-Stokes equations to a steady state. This method is a generalization of a method used by Crocco and also by Allen and Cheng. It is shown that for a simple heat equation that this is just a renormalization of the time. For a convection-diffusion equation the renormalization is dependent only on the viscous terms. The method for the Navier-Stokes equations was implemented using a Runge-Kutta algorithm. This enables the time step to be chosen based on the inviscid model only. The use of residual smoothing when viscous terms are present was discussed. Author

N86-26565*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
CONDITIONS FOR THE CONSTRUCTION OF MULTI-POINT TOTAL VARIATION DIMINISHING DIFFERENCE SCHEMES
Antony Jameson and Peter D. Lax (New York Univ., New York) *In* NASA. Langley Research Center Advances in Numerical and Applied Mathematics Mar. 1986 p 361-381 (For primary document see N86-26552 17-34)
Avail: NTIS HC A25/MF A01 CSCL 20D

Conditions are derived for the construction of total variation

diminishing difference schemes with multi-point support. These conditions, which are proved for explicit, implicit, and semi-discrete schemes, correspond in a general sense to the introduction of upwind biasing. Author

N86-26566*# California Univ., Los Angeles. Dept. of Mathematics.
SOME RESULTS ON UNIFORMLY HIGH ORDER ACCURATE ESSENTIALLY NON-OSCILLATORY SCHEMES
Ami Harten, Stanley Osher, Bjorn Engquist, and Sukumar R. Chakravarthy (Rockwell International Science Center, Thousand Oaks, Calif.) *In* NASA. Langley Research Center Advances in Numerical and Applied Mathematics Mar. 1986 p 383-436 (For primary document see N86-26552 17-34)
(Grants NAG1-270; NCA2-IR-390-403; NSF DMS-85-03294; DAAG29-85-K-0190)
Avail: NTIS HC A25/MF A01 CSCL 20D

The construction and the analysis of essentially nonoscillatory shock capturing methods for the approximation of hyperbolic conservation laws are continued. These schemes share many desirable properties with total variation diminishing (TVD) schemes, but TVD schemes have at most first order accuracy in the sense of truncation error, at extrema of the solution. An hierarchy of uniformly high order accurate approximations of any desired order of accuracy which are tailored to be essentially nonoscillatory are constructed. The design involves an essentially nonoscillatory piecewise polynomial reconstruction of the solution from its cell averages, time evolution through an approximate solution of the resulting initial value problem, and averaging of this approximate solution over each cell. To solve this reconstruction problem, an interpolation technique was used that when applied to piecewise smooth data gives high order accuracy whenever the function is smooth but avoids a Gibbs phenomenon at discontinuities. Author

N86-26567*# Technische Hogeschool, Delft (Netherlands).
ON NUMERICAL DISPERSION BY UPWIND DIFFERENCING
Bram vanLeer *In* NASA. Langley Research Center Advances in Numerical and Applied Mathematics Mar. 1986 p 437-448 (For primary document see N86-26552 17-34)
Avail: NTIS HC A25/MF A01 CSCL 20D

Upwind-biased difference schemes for the linear one-dimensional convection equation are defined. It is demonstrated that the numerical dispersion caused by such schemes changes sign in the middle of the allowed Courant-Friedrichs-Lewy (CFL) number range. This makes it possible to annihilate dispersive errors in two steps. Author

N86-26568*# Los Alamos National Lab., N. Mex. Theoretical Div.
AZTEC: A FRONT TRACKING CODE BASED ON GODUNOV'S METHOD
Blair K. Swartz and Burton Wendroff *In* NASA. Langley Research Center Advances in Numerical and Applied Mathematics Mar. 1986 p 449-466 (For primary document see N86-26552 17-34)
(Contract W-7405-eng-36)
Avail: NTIS HC A25/MF A01 CSCL 20D

AZTEC (Adaptive Zoom Tracking-Experiment Code) is a code to solve the one-dimensional gas dynamic equations in a variable area duct with specific implementation for plane, cylindrical, and spherical geometries. The program uses a fixed, locally and adaptively refinable grid, together with a set of moving grid points which migrate through the fixed grid. The moving points represent shocks or contact discontinuities, and can be created or destroyed, usually as the result of a collision. The basic difference scheme for both the fixed and moving grid is Godunov's method, with the Riemann solver used to compute both cell boundary fluxes and the speeds of the moving points. Tracking of rarefaction waves on the moving grid is difficult with this method since the waves must be represented as piecewise constant. In one version the polytrophic gas equation of state was replaced by one in which the pressure is a continuous piecewise linear function of specific volume at constant entropy. With this assumption the solution of each Riemann problem is piecewise constant, and the method is exact until the wave structure becomes too complicated. Some preliminary numerical results are exhibited. Author

N86-26569*# Carnegie-Mellon Univ., Pittsburgh, Pa.
LEAST SQUARES FINITE ELEMENT SIMULATION OF TRANSONIC FLOWS
T. F. Chen and G. J. Fix *In* NASA. Langley Research Center Advances in Numerical and Applied Mathematics Mar. 1986 p 467-493 (For primary document see N86-26552 17-34)
(Contracts NAS1-17070; NAS1-18107; DAAG29-83-K-0084)
Avail: NTIS HC A25/MF A01 CSCL 20D

Finite difference approximation of transonic flow problems is a well developed and largely successful approach. Nevertheless, there is still a real need to develop finite element methods for applications arising from fluid-structure interactions and problems with complicated boundaries. A least squares based finite element scheme was introduced. It is shown that, if suitably formulated, such an approach can lead to physically meaningful results. Bottlenecks that arise from such schemes are also discussed. Author

N86-26570*# Brookhaven National Lab., Upton, N. Y. Dept. of Applied Mathematics.
THE WEAK ELEMENT METHOD APPLIED TO HELMHOLTZ TYPE EQUATIONS
Charles I. Goldstein *In* NASA. Langley Research Center Advances in Numerical and Applied Mathematics Mar. 1986 p 495-531 (For primary document see N86-26552 17-34)
(Contract DE-AC02-76CH-00016)
Avail: NTIS HC A25/MF A01 CSCL 20D

Helmholtz type boundary value problems are important in a variety of scattering and diffraction problems. Standard numerical schemes based on finite difference, finite element, or integral equation methods are generally not well suited for these problems in the intermediate frequency range since the oscillatory solution is not accurate approximated by piecewise polynomials. A version of the weak element method is employed to numerically solve these problems in two dimensions. This method consists of partitioning the domain into small elements and locally approximating the solution in each element by a sum of exponentials. These piecewise approximations are joined together at interelement boundaries by continuity conditions for certain functionals of the approximate solution. The method is analyzed using a complementary variational formulation. It is shown that the weak element method is considerably more accurate than standard discretization methods when the solution is adequately approximated locally by the exponential basis functions. These results are validated by numerical experiments. Author

N86-26571*# Columbia Univ., New York. Dept. of Applied Physics and Nuclear Engineering.
THE LOCAL REDISTRIBUTION OF POINTS ALONG CURVES FOR NUMERICAL GRID GENERATION
Peter R. Eiseman *In* NASA. Langley Research Center Advances in Numerical and Applied Mathematics Mar. 1986 p 533-556 (For primary document see N86-26552 17-34)
(Grants NAG1-479; NAG1-427; AF-AFOSR-0176B-82)
Avail: NTIS HC A25/MF A01 CSCL 20D

A methodology is established to cluster points along curves in a manner which does not change the existing pointwise distribution outside of a specific region containing the cluster. In each instance, points are pulled from the perimeters of the region towards the cluster center. The result is a smooth expansion from each end followed by a compression into the center. Altogether, this represents a local redistribution of points which can be employed either interactively or automatically. Author

N86-26572*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON SIMILARITY SOLUTIONS OF A BOUNDARY LAYER PROBLEM WITH AN UPSTREAM MOVING WALL
M. Y. Hussaini, W. D. Lakin (Old Dominion Univ., Hampton, Va.), and A. Nachman (Air Force Office of Scientific Research, Bolling

AFB, Washington, D.C.) *In its* Advances in Numerical and Applied Mathematics Mar. 1986 p 557-580 (For primary document see N86-26552 17-34)
(Contracts NAS1-17070; NAS1-18107)
Avail: NTIS HC A25/MF A01 CSCL 20D

The problem of a boundary layer on a flat plate which has a constant velocity opposite in direction to that of the uniform mainstream was examined. It was previously shown that the solution of this boundary value problem is crucially dependent on the parameter which is the ratio of the velocity of the plate to the velocity of the free stream. In particular, it was proven that a solutin exists only if this parameter does not exceed a certain critical value, and numerical evidence was adduced to show that this solution is nonunique. Using Crocco formulation the present work proves this solution is nonunique. Also considered are the analyticity of solutions and the derivation of upper bounds on the critical value of wall velocity parameter. Author

N86-26573*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON THE ADVANTAGES OF THE VORTICITY-VELOCITY FORMULATION OF THE EQUATIONS OF FLUID DYNAMICS
Charles G. Speziale *In its* Advances in Numerical and Applied Mathematics Mar. 1986 p 581-589 (For primary document see N86-26552 17-34)
(Contract NAS1-18107)
Avail: NTIS HC A25/MF A01 CSCL 20D

The mathematical properties of the pressure-velocity and vorticity-velocity formulations of the equations of viscous flow are compared. It is shown that a vorticity-velocity formulation exists which has the interesting property that noninertial effects only enter into the problem through the implementation of initial and boundary conditions. This valuable characteristic, along with other advantages of the vorticity-velcoity approach, are discussed in detail. Author

N86-26574# Admiralty Marine Technology Establishment, Teddington (England). Inst. of Sound and Vibration Research.
COMPARISON OF MEASURED AND COMPUTED BOUNDARY LAYERS AT THE TAIL-END OF TWO AXISYMMETRIC BODIES IN THE ARE QUIET WIND TUNNEL
G. J. Cooper, comp. Jun. 1985 28 p Presented at EC-5 Intern. Workshop on Electron Cyclotron Emission and Electron Cyclotron Heating and Gyrotron User/Developer Meeting, San Diego, Calif., 9-12 Nov. 1985 Sponsored by Admiralty Research Establishment, Teddington, England
(AMTE(N)-TM-84063; BR97645; ESA-86-96849) Avail: Issuing Activity

Velocity profiles measured at the tail end of two axisymmetric bodies are compared with velocity profiles produced by a potential flow and first order boundary layer computer model. The computer program can produce excellent agreement with measured data if the boundary layer transition position can be optimized in the computation. The program is valuable in determining the model and duct configuration most suitable for simulating a particular full scale situation. Preliminary testing of models may be necessary to establish the actual boundary layer transition position, and to change it using a boundary layer trip device, or to optimize the position selected for the computation. ESA

N86-26575*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ACTIVE CONTROL OF BOUNDARY LAYER TRANSITION AND TURBULENCE Patent Application
Lucio Maestrello, inventor (to NASA) Filed 11 Mar. 1986 13 p
(NASA-Case-LAR-13532-1; NAS 1.71:LAR-13532-1;
US-Patent-Appl-SN-838649) Avail: NTIS HC A02/MF A01 CSCL 20D

The invention is a system and method for controlling boundary layer flow such that flow separation can be delayed and skin friction drag can be reduced. The invention consists of heater elements used to trigger turbulent flow and audio speakers used to suppress turbulent oscillations. By inducing turbulent oscillations into the flow in a region of positive pressure gradient, pressure patterns became more regular. The suppression of these patterns can be accomplished by imposing an out-of-phase suppressing wave. This wave is the audio output generated by a feedback amplifier using inputs from a hot-wire anemometer reading downstream turbulence. The novel features of the present invention are the tripping of boundary layer flow in a region of positive pressure gradient and the cooperative use of the feedback means to control turbulence. The result is a significant reduction in drag and separation problems. NASA

N86-26576# Wisconsin Univ., Madison. Mathematics Research Center.
REGULARITY FOR A SINGULAR CONSERVATION LAW Technical Summary Report
R. E. Meyer Sep. 1985 55 p refs
(Contract DAAG29-80-C-0041; Grant NSF MCS-82-15064)
(AD-A163620; MRC-TSR-2871) Avail: NTIS HC A04/MF A01 CSCL 20/4

The main structure underlying the nonlinearity of conservation laws of gasdynamical type in two independent variables is discussed at the hand of a canonical example describing also properties of water waves near shore. The ultimately singular nature of such laws is here the central issue and calls for an unusual formulation. Attention is directed to the globally strong solutions, and an unusual regularization is employed to make them accessible, after illposedness is overcome. The usual regularity theory is not normally sufficient for singular partial differential equations, and the neccessry additional chapter on extensions to the singular locus is developed in detail for the canonical example. Criteria for the relation between regularized and strong solutions are discussed and used to characterize the class of solutions that are globally strong in the strictest sense. GRA

N86-26577# Wisconsin Univ., Madison. Mathematics Research Center.
POINTED BUBBLES RISING IN A TWO-DIMENSIONAL TUBE Technical Summary Report
Jean-Marc Vanden-Broeck Dec. 1985 12 p
(Contract DAAG29-80-C-0041; Grant NSF MCS-80-01960)
(AD-A163624; MRC-TSR-2893) Avail: NTIS HC A02/MF A01 CSCL 20/4

This document considers a periodic array of plane bubbles rising in a gravity field. This configuration can serve as a model for an advanced stage of Rayleigh-Taylor instability. Vanden-Broeck solved the problem numerically and showed that two classes of solutions are possible. One class is characterized by a bubble profile with a continuous slope at the apex of the bubble whereas the other is characterized by the presence of a cusp at the apex. In a recent paper Garabedian and Modi conjectured that solutions with a 120 deg. angle at the apex might also exist. In this paper a scheme is presented to compute such solutions. It is found that a solution exists at a unique Froude number of 0.36. This result does not support Garabedian's conjecture that bubbles with a 120 deg. angle at the apex exist for all values of F between 0.23 and 0.36. GRA

N86-26578# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A STUDY OF THE FLUID-DYNAMIC PRESSURE FIELDS ON COMPRESSOR REED VALVES M.S. Thesis
Robert D. Hunt Dec. 1985 120 p refs
(AD-A164102; AFIT/GAE/AA/85D-09) Avail: NTIS HC A06/MF A01 CSCL 20/4

The flow induced pressure field in a reed valve arrangement was analytically predicted and experimentally measured for steady state conditions. The flow was found to be supersonic in nature with an imbedded shock for all but the lowest pressure runs. The analytic method used one-dimensional isentropic and normal shock relations. The technique provides a good first look at the nature of the flow and is compatible for use on a small computer system. The experimental data was obtained by using an idealized reed valve model. The data acquisition system was

computerized and used a scanivalve system to measure the pressure in the valve model. Circular, square, and rectangular valve plate geometries were investigated. The inlet was circular for all cases. Flow visualization oil was also used in a qualitative approach to determine the location and shape of the shock in the flow. The pressure measurements and the flow visualization showed the shock to be circular for all geometries and pressures tested. At high total pressure runs the valve plate began vibrating and the shock location became smeared suggesting the shock was also oscillating. GRA

N86-26579# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
HYDRAULIC POWER MODULATION LAMINAR PROPORTIONAL AMPLIFIER DEVELOPMENT
K. M. Lee and D. N. Wormley Nov. 1985 88 p
(Contract DAAK21-81-C-0122; DA Proj. 1L1-61102-AH-44)
(AD-A163390; HDL-CR-85-122-1) Avail: NTIS HC A05/MF A01 CSCL 20/4

A basic analytical and experimental study of the influence of geometry on laminar proportional fluidic amplifier characteristics has been conducted. Performance characteristics for current HDL C-Format amplifier designs as well as new configurations have been determined to identify the design tradeoffs among characteristics including blocked load gain, pressure recovery, flow recovery, efficiency, laminar operating range and dynamic response. The results of the study have led to the development and testing of a laminar proportional amplifier (LPA) specifically designed for power modulation applications. The power modulation amplifier has a nozzle to splitter distance which is 37.5 percent of the standard LPA design and as a result has a blocked load pressure gain which is approximately 35 percent of that of the standard LPA, but has a pressure recovery, 1.35 times and efficiency double the respective values of the standard LPA. In addition, the power modulation LPA has an increased operating range with respect to temperature variations and increased dynamic response with an increase in the frequency at which 90 degrees phase shift occurs in the frequency response by a factor of 2.6. The increased pressure recovery and efficiency can lead to reductions in fluidic system size and weight for applications in which power modulation is of prime importance. GRA

N86-26580# Woods Hole Oceanographic Institution, Mass.
SUMMER STUDY PROGRAM IN GEOPHYSICAL FLUID DYNAMICS, WOODS HOLE OCEANOGRAPHIC INSTITUTION: CHAOS
George Veronis and Linda M. Hudon Nov. 1985 280 p refs
(Contract N00014-82-G-0079; Grants NSF MSC-82-000450; NSF DMS-85-04166)
(AD-A164601; WHOI-85-36) Avail: NTIS HC A13/MF A01 CSCL 20/4

The explosive growth of dynamical system theory stems in large part from the realization that it is applicable to many natural phenomena. Indeed, much of the theoretical development has been sparked by numerical and laboratory experiments which exhibit ordered sequences of behavior that call for a general framework of interpretation. Five lectures exposed us to elementaty examples of bifurcation and chaos, to symmetry breaking, normal forms and temporal and spatial disorder, as well as to pertinent fluid mechanical and astrophysical phenomena. In addition are the development with an elegant summary of different types of intermittency; Seminars on phase instability and turbulence as an extension of the lecture series; and the fascinating correspondence between the frequencies observed in one recent fluid mechanics experiment, and results from number theory relating the Fibonacci series to the golden mean. GRA

N86-26581# Cornell Univ., Ithaca, N.Y. Dept. of Applied and Engineering Physics.
VORTICITY OPTICAL PROBE Final Technical Report, 1 Jun. 1983 - 14 Apr. 1985
14 Apr. 1985 9 p refs
(Contract N00014-83-K-0460)
(AD-A164619) Avail: NTIS HC A02/MF A01 CSCL 20/4

The design, construction, and testing of a new scale flow system is discussed. It appears from preliminary examination that this flow system generates a turbulent boundary layer suitable for wide ranging study of vorticity dynamics. Verification that the flow exhibits normal boundary layer characteristics with both flow visualization and hot-film anemometry is under way. The Vorticity Optical Probe (VOP) provides a measure of local vorticity fluctuations. Ideally, the study of boundary layer turbulence would be conducted on a smooth flat plate with uniform flow at infinity, no plate end effects, and neglegible disturbance by extended flow structures and background turbulence in the incident flow. To minimize the scale and cost of the tunnel, compromises were required. Nonetheless, it was our goal to simulate the above free boundary layer conditions, to the maximum extent that this is possible in a modest scale flow tunnel suited to application of the VOP geometry using the available technical experience, in order to confirm the precision and accuracy of the probe for study of the vorticity dynamics of both transitional and turbulent flow and to carry out precise studies on well defined flows. GRA

N86-26582# Naval Ship Research and Development Center, Bethesda, Md.
INFINITE ELEMENTS FOR TWO-DIMENSIONAL FLUID-STRUCTURE INTERACTION PROBLEMS
Erwin A. Schroeder Feb. 1986 22 p
(AD-A164749; DTNSRDC-86/001) Avail: NTIS HC A02/MF A01 CSCL 13/10

This report describes an effective method for using two-dimensional infinite elements to compute acoustic or magnetic fields in the unbounded fluid region surrounding a submerged vehicle. In this method, finite elements represent the bounded region containing the vehicle and may also be used to represent a layer of fluid surrounding the vehicle. Infinite elements are used to represent the unbounded exterior region. Since infinite elements are not bounded, their shape functions are chosen to contain decay factors to produce convergent integrals. If, from physical or other considerations, the order of decay of the solution as the radius increases is known, infinite elements should be chosen with the same order of decay. The results obtained in this study were found to be within 2% when the decay factor of infinite elements matched that of the solution. However, for other problems, the order of decay of the solution may not be known in advance, and, therefore, it may not be possible to match the two rates of decay. For such cases, the errors were found to be as large as 20%. In such situations, a layer of finite fluid elements, two elements thick around the structure, reduced the errors to less than 3.5% for the modes and decay factors tested. GRA

N86-26583# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
THREE-DIMENSIONAL SEPARATION AND VORTICAL WAKES OVER A PROLATE SPHEROID Final Report
Demetri P. Telionis and Christopher E. Costis Sep. 1985 51 p
(Contract N00167-84-C-0044)
(AD-A164781; VPI-E-86-1; DTNSRDC/ASED-CR-01-85) Avail: NTIS HC A04/MF A01 CSCL 20/4

A vortex lattice code was developed to generate potential flow solutions over three dimensional bodies. An approximate boundary layer technique is incorporated to allow the calculation of the line separation. The separated vortex sheets are modeled in terms of a vortex grid which is convected with the flow. Special conditions at separation determine the strength of nascent vorticity. Viscous inviscid interaction in three dimensions allows the accurate prediction of the line of separation and the pressure distribution over the attached flow region. GRA

N86-26584# Carnegie-Mellon Univ., Pittsburgh, Pa.
ANNUAL PROGRESS REPORT, 1 JUNE 1984-31 MAY 1985
Nicolaides Nov. 1985 6 p Submitted for publication
(Grant AF-AFOSR-0137-84)
(AD-A164853; AFOSR-86-0001TR) Avail: NTIS HC A02/MF A01 CSCL 20/4

The use of certain nonconforming schemes for solving

viscous incompressible flow problems was put on a rigorous foundation, and the resulting theory was used to construct new convergent schemes. The investigator was able to show that a certain nonconforming quadratic element actually has the same accuracy as a well known nonconforming cubic. This is of great practical significance because the costs of implementing the quadratic elements are far less than those for cubics. GRA

N86-26585# Ballistic Research Labs., Aberdeen Proving Ground, Md.
FREE GYROSCOPE EXPERIMENTS OF TWO IMMISCIBLE LIQUIDS IN A PARTIALLY FILLED CYLINDER Final Report
Lyle D. Kayser, William P. DAmico, Jr., and William I. Brannan Dec. 1985 30 p
(AD-A164937; BRL-MR-3484) Avail: NTIS HC A03/MF A01 CSCL 20/4

Gyroscope experiments have been conducted to measure the yaw growth rate in a cylinder filled with two immiscible liquids (silicone oil and water). The experimental data were obtained by measuring the yaw history was processed to obtain the yaw growth rate induced by the liquid. Yaw histories were obtained for a 90% filled cylinder (height - 25.78 cm and diameter = 8.24 cm) spinning at 50 rev/sec. The aspect ratio (height/diameter) of the cylinder was 3.126. The composition of the liquid payload was changed by varying the oil to water ratios - ratios of 100/0, 85/15, 75/25, 30/70, 15/85, and 0/100 were tested. The experimental data were found to be consistent with a recent theory by Murphy. However, a small, but consistent, bias was observed between the measured and predicted values of yaw frequency at the maximum growth rate; the experimental values were slightly larger.
Author (GRA)

N86-26586# Villanova Univ., Pa. Dept. of Mechanical Engineering.
A PHYSICAL MODEL AND CONSERVATION EQUATION FOR DYNAMIC SOLID-LIQUID BEHAVIOR Progress Report, Aug. 1983 - Apr. 1985
John N. Majerus Feb. 1986 102 p
(Contract DAAK11-83-K-0009)
(AD-A165295; BRL-CR-551) Avail: NTIS HC A06/MF A01 CSCL 20/4

A self-consistent set of equations were developed for 3-D penetration problems. The set of equations includes polymorphic and thermodynamic phase changes, finite material extensions and rotations between time-steps, thermal softening, Hugioniot volumetric relationships, strain and strain-rate dependency for elastic-viscoplastic deviatoric behavior, generalized inertial forces, and conductive, convective and radiation heat fluxes. Continuous mapping between fluid and solid states were obtained by selecting velocity and temperature as the primary variables. The resulting set of mass, linear momentum and energy equations form a coupled set of differential and integral-differential equations. These equations were approximated by discretizing in both time and space via the method of weighted residuals using piecewise continuous weighting and trial functions. A quadratic time-element was assumed and a wide variety of algebraic recursion relationships were derived for the corresponding implicit solution schemes. In order to quickly evaluate any of these solution schemes, a new concept entitled creation and annihilation was introduced where geometric sub-regions are added to, and subtracted from, the geometric problem during the penetration process. GRA

N86-26587# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Chemical and Environmental Engineering.
EFFECT OF LIQUID COMPOSITION ON ENHANCED FLOW DUE TO SURFACE SHEAR IN THE CONTACT LINE REGION: CONSTANT VAPOR PRESSURE BOUNDARY CONDITION
P. C. Wayner, Jr. and C. J. Parks 1985 8 p
(Contract DAAG29-83-K-0058)
(AD-A165545; ARO-19879.17-EG) Avail: NTIS HC A02/MF A01 CSCL 07/4

The physicochemical phenomena associated with fluid flow in an evaporating ultrathin film of an ideal binary mixture in the contact line region are discussed. The effect of composition and temperature gradients on surface shear is analyzed and the results are compared with experimental trends. Although simple in concept, the constant vapor pressure boundary condition appears to be very useful in delineating the relative effects of surface tension, temperature and composition on fluid flow due to surface tension gradients in general. GRA

N86-26588# Oak Ridge National Lab., Tenn.
ENERGY DEPOSITION, HEAT FLOW AND RAPID SOLIDIFICATION DURING LASER AND ELECTRON BEAM IRRADIATION OF MATERIALS
C. W. White and M. J. Aziz Oct. 1985 57 p Presented at the ASM Metals Congress - International Conference on Surface Modifications, Toronto, Ontario, 13 Oct. 1985
(Contract DE-AC05-84OR-21400)
(DE86-002240; CONF-8510160-7) Avail: NTIS HC A04/MF A01

The fundamentals of energy deposition, heat flow, and rapid solidification during energy deposition from lasers and electron beams is reviewed. Emphasis is placed on the deposition of energy from pulsed sources (10 to 100 ns pulse duration time) in order to achieve high heating and cooling rates (10(8) to 10(10) (0)C/s) in the near surface region. The response of both metals and semiconductors to pulse energy deposition is considered. Guidelines are presented for the choice of energy source, wavelength, and pulse duration time. DOE

N86-26589# Holmes and Narvier, Inc., Mercury, Nev.
HEAT PUMP STRATEGY AT THE NEVADA TEST SITE
R. E. Davis 1985 4 p Presented at the 8th World Engineering Congress, Atlanta, Ga., 22 Oct. 1985
(Contract DE-AC08-76NV-00020)
(DE85-013669; CONF-851002-1) Avail: NTIS HC A02/MF A01

The high desert location of the Nevada Test Site (NTS) provides both high and low temperature extremes during the course of a year. The remoteness of the NTS resulted in the selection of electricity as the principal energy source for environmental conditioning systems. These two factors have led the facility designers at the NTS to select the technology of heat pumps as the principal means of providing air conditioning for new facilities. This paper discusses the installations of heat pumps at the NTS over the past five years. Air-to-air heat pumps installed at the NTS include split systems, single package systems, and through-the-wall systems. A large central plant closed cycle water-to-air heat pump system is also described. The results of a recent analysis of an open cycle water source heat pump system are also presented. DOE

N86-26590# Lawrence Livermore National Lab., Calif.
TOPAZ3D: A THREE-DIMENSIONAL FINITE ELEMENT HEAT TRANSFER CODE
A. B. Shapiro Aug. 1985 61 p
(Contract W-7405-eng-48)
(DE85-017878; UCID-20484) Avail: NTIS HC A04/MF A01

TOPAZ3D is a three dimensional implicit finite element computer code for heat transfer analysis. A user's manual for TOPAZ3D is provided as is a description of the numerical algorithms used. Sample problems with analytical solutions are presented. TOPAZ3D was implemented on the Cray and Vax computers. TOPAZ3D can be used to solve for the steady state or transient temperature field on three dimensional geometries. Material properties may be temperature dependent and either isotropic or orthotropic. A variety of time and temperature dependent boundary conditions can be specified including temperature, flux, convection, and radiation. By implementing the user subroutine feature, users can model chemical reaction kinetics and allow for any type of functional representation of boundary conditions and internal heat generation. TOPAZ3D can solve problems of diffuse and specular band radiation in an enclosure coupled with conduction in the material surround the enclosure. Additional features include thermal contact resistance across an interface, bulk fluids, phase change, and energy balances. Thermal stresses can be calculated using the solid mechanics code NIKE3D which reads

the temperature state data calculated by TOPAZ3D. TOPAZ3D is an extension of the two dimensional heat transfer code TOPAZ to three dimensions. DOE

N86-26591# Los Alamos National Lab., N. Mex.
CALCULATION OF SLIDING INTERFACES OF TWO-DIMENSIONAL UNSTEADY FLOW
H. Kao-yu and C. Kuang-i 1985 16 p Transl. into ENGLISH from Pao-cha yu ch'ung-chi, v. 3, no. 10, 1983 p 10-18
(Contract W-7405-eng-36)
(DE86-005003; LA-tr-86-1) Avail: NTIS HC A02/MF A01

A new technique is described for the numerical investigation of time-dependent elastic-plastic flow with sliding interfaces. The Lagrangian equations of sliding motion are derived analytically; detailed results for sliding interfaces are described. Numerical simulation results of a standard cylinder test are in good agreement with experimental data. In the problem of two-dimensional unsteady flow, sliding (contact interruption) is a kind of mechanical phenomenon frequently occurred. On a sliding plane, the normal-direction velocity of the sliding object is continuous while the tangential-direction velocity is interrupted. The differential equation for motion does not apply, therefore another group of sliding-motion equations should be used instead. In the paper, the following conditions are assumed: elastic-plastic flow, and frictionless (nonviscous) sliding plane. An analysis method is used to derive the sliding motion equations. In addition, a type of difference model is presented for the sliding motion equations. Finally, an example is given for numerical calculation. DOE

N86-26592# Sandia National Labs., Livermore, Calif.
TOPAZ - THE TRANSIENT ONE-DIMENSIONAL PIPE FLOW ANALYZER: EQUATIONS AND NUMERICS
W. S. Winters Dec. 1985 42 p
(Contract DE-AC04-76DR-00789)
(DE86-005063; SAND-85-8248) Avail: NTIS HC A03/MF A01

TOPAZ is a user friendly computer code for modeling the one-dimensional, transient physics of multi-species gas transfer in arbitrary arrangements of pipes, valves, vessels, and flow branches. This report, the third in a series of reports documenting TOPAZ, deals exclusively with governing equations, numerical methods, and code architecture. DOE

N86-26593# Thermo Electron Corp., Waltham, Mass.
CERAMIC HEAT PIPE WASTE HEAT RECOVERY, PHASE 1 Report, 1 Aug. 1984 - 30 Apr. 1985
May 1985 90 p
(Contract DE-AC07-84ID-12532)
(DE86-005350; DOE/ID-12532/1) Avail: NTIS HC A05/MF A01

This report describes design simplifications and mass production concepts that can achieve a heat pipe cost of $448 each. A ceramic heat pipe recuperator design is presented which addresses fouling, cleaning, sealing and maintainability. Overall dimensions including ducts, flanges and insulation are 16 x 5 1/2 x 6 1/2 feet. The weight is 12.5 tons. The simple payback for the system is 0.73 year. A plan for Phase 2 work is presented, which addresses verification of the concepts developed in the study. DOE

N86-26594# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
PRODUCTION OF TURBULENCE ACCORDING TO THE TRANSPORT EQUATIONS
B. vandenBerg 16 Apr. 1984 17 p
(NLR-MP-84030-U; B8578432; ESA-86-96967) Avail: NTIS HC A02/MF A01

The turbulence transport equations are reviewed. The role of the pressure-strain term is studied. It is shown that the pressure-strain term exactly cancels the production term when the Taylor hypothesis or frozen turbulence approximation holds. The consequences of this result for the interpretation of the turbulence transport equations are discussed. ESA

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N86-26595* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOLID SORBENT AIR SAMPLER Patent
Theodore J. Galen, inventor (to NASA) (Northrop Services, Inc., Houston, Tex.) Issued 29 Apr. 1986 7 p Supersedes N85-20301 Filed 10 Oct. 1984 Sponsored by NASA Sponsored by NASA
(NASA-CASE-MSC-20653-1; US-Patent-4,584,887; US-Patent-Appl-SN-659474; US-Patent-Class-73-863.31; US-Patent-Class-73-863.21; US-Patent-Class-73-864.34; US-Patent-Class-73-863.72) Avail: US Patent and Trademark Office CSCL 14B

A fluid sampler for collecting a plurality of discrete samples over separate time intervals is described. The sampler comprises a sample assembly having an inlet and a plurality of discreet sample tubes each of which has inlet and outlet sides. A multiport dual acting valve is provided in the sampler in order to sequentially pass air from the sample inlet into the selected sample tubes. The sample tubes extend longitudinally of the housing and are located about the outer periphery thereof so that upon removal of an enclosure cover, they are readily accessible for operation of the sampler in an analysis mode.
Official Gazette of the U. S. Patent and Trademark Office

N86-26596*# Sverdrup Technology, Inc., Cleveland, Ohio.
CALIBRATION OF DROPLET SIZING AND LIQUID WATER CONTENT INSTRUMENTS: SURVEY AND ANALYSIS Interim Report
Edward C. Hovenac May 1986 30 p refs Sponsored in part by FAA, Atlantic City, N.J.
(Contract NAS3-24105)
(NASA-CR-175099; E-3025; NAS 1.26:175099; FAA-CT-86-19) Avail: NTIS HC A03/MF A01 CSCL 14B

Results are presented for phase 1 of an effort to establish a unified calibration capability for instruments used for aircraft icing certification and aircraft icing research. Various calibration, data correction, and verification procedures are reviewed and some new techniques are developed for droplet sizing instruments and liquid water content meters. These instruments include a forward scattering spectrometer probe, an optical array probe, and hot-wire type liquid water content meters. Work planned for phase 2 of the effort is described. Author

N86-26597# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
CONCEPTION AND OPTIMIZATION OF AN INFRARED THERMAL SENSOR USING THE VALUE ANALYSIS METHOD
Mario Marcos QuintinodaSilva and Luis Antonio Waack Bambace Apr. 1986 6 p Presented at TELECON'85, Rio de Janeiro, Brazil, 10-13 Dec. 1985
(INPE-3854-PRE/918) Avail: NTIS HC A02/MF A01

Infrared sensors are necessary in infrared simulation of satellites. The methodology of Value Analysis is used to obtain better sensors than those available in the market at lower cost and with the same or even better performance, taking into account the restrictions on the project inside the facilities. Author

N86-26598*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PLANAR OSCILLATORY STIRRING APPARATUS Patent Application
Martin F. Wolf, inventor (to NASA) (Stanford Univ., Calif.) Filed 15 Aug. 1985 15 p

(Contract NAS8-34872)
(NASA-Case-MFS-26002-1-CU; NAS 1.71:MFS-26002-1-CU; US-Patent-Appl-SN-765991) Avail: NTIS HC A02/MF A01 CSCL 14B

The present invention is directed to an apparatus for stirring materials using planar orthogonal axes oscillations. The apparatus has a movable slide plate sandwiched between two fixed parallel support plates. Pressurized air is supplied to the movable slide plate which employs a tri-arm air bearing vent structure which allows the slide plate to float and to translate between the parallel support plates. The container having a material to be stirred is secured to the upper surface of the slide plate through an aperture in the upper support plate. A motor driven eccentric shaft loosely extends into a center hole bearing of the slide plate to cause the horizontal oscillations. Novelty lies in the combination of elements which exploits the discovery that low frequency, orthogonal oscillations applied horizontally to a Bridgman crucible provides a very rigorous stirring action, comparable with and more effective by an order of magnitude than the accelerated crucible rotation technique. NASA

N86-26599*# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Mechanical Engineering, Aeronautical Eng.
POLARIZATION MODULATED ELLIPSOMETRY Final Report
James L. Lauer and Norbert Marxer 10 Jul. 1986 114 p
(Grant NAG3-222)
(NASA-CR-177264; NAS 1.26:177264) Avail: NTIS HC A06/MF A01 CSCL 14B

For the investigation of the composition and thickness of thin nonuniform films on bearing and other tribological surfaces an automated ellipsometer was built, which is extremely sensitive to relative changes in thickness and composition of surface films. These changes can be seen by scanning across the surface with 20 micrometer lateral resolution. By measuring at different angles of incidence one can determine the film thickness and identify the material of the film by its complex index of refraction. For the analysis of organic layers on top of several metallic layers it was necessary to develop mathematical procedures to increase the absolute precision of the instrument. The ellipsometer is described in detail, and the precision is discussed. The actual performance of the ellipsometer was tested on three experiments. In the first one the composition and thickness of patches of an oxide film inside a wear track were determined. In the second the thickness of a carbon overcoat sputtered on a computer disk was measured: the carbon was identified as graphitic and of random orientation. In the third thickness of silicon oxide on top of a silicon substrate was found. Important features of this apparatus are: (1) accurate settings of the polarization stages and the angle of incidence (both automated); (2) high precision in the determination of the ellipsometric parameters without calibration prior to an experiment; and (3) very accurate scanning modes with high spatial resolution. Author

N86-26600# Office of Naval Research, London (England).
STATE-OF-THE-ART SURVEY OF GYROTRON RESEARCH: AN ONRL SPONSORED WORKSHOP
Paul Roman 10 Jan. 1986 9 p Workshop held in London, Engl., 25-26 Nov. 1985
(AD-A163580; ONRL-C-14-85) Avail: NTIS HC A02/MF A01 CSCL 09/1

A thorough review of the past history and the current work on the fast-wave amplifiers performed at NRL is presented. Two current NRL research projects in the plasma physics division are on highly relativistic gyrotrons, and on the design and initial performance of cyclotron autoresonance masers. An overview of applications of gyrotrons in the area of electron cyclotron resonance plasma heating for fusion experiments is presented as is a status report on the latest design results of a 150 GHz overmoded gyrotron development project at the German Nuclear Research Institute in Karlsruhe whose purpose is to study higher modes in circular gyrotrons with increasing output power. Current and planned gyrotron development studies within the framework of the Fusion Programme of the Commission of the European Communities are discussed as is work on high peak power gyroklystron amplifiers. GRA

N86-26601# Naval Postgraduate School, Monterey, Calif.
DEVELOPMENT OF A TESTBED FOR MULTISENSOR DISTRIBUTED DECISION ALGORITHMS M.S. Thesis
Mark A. Schon Dec. 1985 85 p refs
(AD-A164487; AD-E900539) Avail: NTIS HC A05/MF A01 CSCL 09/2

Distributed decision problems arise when two or more sensors viewing the same phenomenon must work cooperatively to draw inferences about the observed situation. Typical examples are in target detection and target classification. Such problems are characterized by distributed processing of information and communication between processors over a limited bandwidth data link. This thesis presents some statistical distributed decision algorithms and describes the implementation of one of them on a set of loosely coupled multiprocessor clusters which simulate the distributed environment characterizing multisensor decision roblems. GRA

N86-26602# Stafford (J.) Associates, San Mateo, Calif.
IMPROVED DESIGNS FOR ISOCON CAMERAS IN HERTR SYSTEMS Final Report, 4 Dec. 1984 - 22 May 1985
Joseph J. Stafford 7 Jun. 1985 28 p refs
(Contract N60921-85-C-0063)
(AD-A164627; NSWC-TR-85-382) Avail: NTIS HC A03/MF A01 CSCL 17/8

The HERTR imaging systems are experiencing Isocon tube failures at a rate which is not typical of more intensely used imaging systems containing Isocon tubes. Heat is the usual cause for early Isocon tube failures. A HERTR system was visited and it was decided that, indeed, heat was the probable cause for a failure. A mechanical design was prepared which was as similar as possible to the major confining structure surrounding the HERTR camera. In subsequent tests with the duplicate structure, the thermal failure mode was duplicated without continuing the tests to completion. A design change was initiated and tested with the duplicate system. Thermal characteristics of the altered system were measured. Additional deficiencies in the HERTR imaging system were noted during the course of the visit to the HERTR site. These deficiencies are also described in this report. Recommendations are made to alter the HERTR design to include the modifications made to the duplicate camera design. In the short term these modifications are simple and inexpensive to implement. Recommendations are also included for an extensive modification to high energy imaging systems, particularly those subject to pulsed operating conditions and to those operating in photon limited situations which is usual in X-ray imaging systems. Author (GRA)

N86-26603# Calspan Advanced Technology Center, Buffalo, N.Y.
AN EVALUATION OF THE CAPABILITY OF THE SURFACE CONDITION ANALYZER (SCAN) SENSORS TO MEASURE RUNWAY WATER DEPTH Final Report, Mar. 1981 - Jan. 1986
C. W. Rogers, E. J. Mack, and B. J. Wattle Jan. 1986 58 p
(Contract N00014-81-C-0443)
(AD-A164719; CALSPAN-6857-M-1) Avail: NTIS HC A04/MF A01 CSCL 14/2

Field tests of Surface Systems, Inc.'s Surface Condition Analyzer's (SCAN) capability to measure runway water depth during rainfall events were performed at the Spirit of St. Louis Airfield, St. Louis, Mo., during March-May of 1985. These limited tests were scheduled to provide data in real rainfall events and to answer questions of sensor capability relative to true runway water depth and or sensor installation and siting protocol--i.e., should the sensor surface be horizontal or flush relative to a sloping runway surface. Field calibration checks showed that sensors installed in the runway surface can measure in-situ water depth in the range 0.030 to 0.40 inches (+ or = 0.01 inches). In real rainfall with rates ranging from 0.30 inches/hour (very light) to 6.0 inches/hour (heavy), it was found that the sensor-measured water depth correlated very well with an independently measured water depth over the range 0.03 to 0.10 inches (maximum observed).

At the lower end of this range, both sensors measured the same water depth, while at the top end, the sloping, flush-mounted sensor indicated only about 75% of the water depth measured independently and by the horizontally mounted sensor. GRA

N86-26604# Naval Ship Research and Development Center, Bethesda, Md. Ship Performance Dept.
DTNSRDC THREE COMPONENT LASER DOPPLER VELOCIMETRY: TOWING TANK SYSTEM MEASUREMENT ERRORS Final Report
David J. Fry 1 Oct. 1985 142 p
(AD-A164743; DTNSRDC/SPD-1163-03) Avail: NTIS HC A07/MF A01 CSCL 14/2

A three-component Laser Doppler Velocimetry (LDV) system is tested. Thirteen measurement errors are quantified in terms of: velocity field characteristics, LDV equipment design, and user chosen system operating parameters. Operating parameter effects on measurement error are emphasized because usually they are the only way an experimenter can control errors. Background sections and appendixes explain in considerable detail, the origin of these measurement errors. First, the operating parameter choices for the towing tank LDV system are listed with a description of how they affect measurements. Then, each of the measurement errors is discussed, and this helps establish a functional relationship to operating parameters, LDV equipment design, and flow field characteristics. GRA

N86-26605# Naval Ship Research and Development Center, Bethesda, Md. Ship Performance Dept.
DTNSRDC THREE COMPONENT LASER DOPPLER VELOCIMETRY: MEAN VELOCITY DATA ANALYSIS
David J. Fry 10 Oct. 1985 130 p
(AD-A164744; DTNSRDC/SPD-1163-02) Avail: NTIS HC A07/MF A01 CSCL 14/2

This report describes how the columinous amount of data from Laser Doppler Velocimetry (LDV) experiments can be distilled to produce useful and comprehendable results. The procedures draw heavily on the experience and development work done in implementing three component LDV systems for the towing tanks and large wind tunnels of the David Taylor Naval Ship Research and Development Center. The standard procedures and computer software described are meant to reduce the time needed to analyze and report LDV experiments. The procedures address data collection, data calibration, measurement error estimation, data display graphics, and short and long term data storage. GRA

N86-26606# Naval Postgraduate School, Monterey, Calif.
A SURVEY OF VIDEODISC TECHNOLOGY M.S. Thesis
Charles W. Davis Dec. 1985 101 p refs
(AD-A164992) Avail: NTIS HC A06/MF A01 CSCL 14/3

In today's computer-based military environment the interactive videodisc offers a means to an efficient education and training system. It allows interactive instruction capable of responding to individual needs. Interactive videodisc also has potential as a mass storage and retrieval system accommodating complete catalogs of printed material. This thesis focuses on a number of studies completed on this new technology. Author (GRA)

N86-26607# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
A STUDY OF THE OPTIMIZATION PROBLEM FOR CALIBRATING A LACOSTE AND ROMBERG G GRAVITY METER TO DETERMINE CIRCULAR ERRORS
Dingbo Chao and Edward M. Baker Sep. 1985 102 p
(Contract F19628-82-K-0017)
(AD-A165218; OSU/DGSS-364; AFGL-TR-85-0208; SR-9) Avail: NTIS HC A06/MF A01 CSCL 08/5

This report discusses how the circular errors of a gravity meter could be effectively calibrated in a laboratory. Minimization of the trace of the variance-covariance matrix of adjusted parameters, is adopted as the criterion for the optimization. The mathematical analysis of the trace is made in the case of one wavelength in order to find the best distribution of observations, as well as the worst. For several wavelengths, a number of simulative computations are carried out for finding effective distribution of observations and the best and worst weights. A set of numerical solutions for the equations over a certain range of observations is obtained. Based on the simulative studies, the concepts of phase distribution and effectiveness of observations in the periodic error calibration are presented and so a design for the most effective distribution of observations is introduced. For the calibration of periodic errors with several wavelengths, it is preferable to select two weights that can be mutually compensated in fitting them with all involved periods. An attempt is made to answer how many observations should be made for determining the periodic screw errors with reasonable accuracy. GRA

N86-26608# United Technologies Research Center, East Hartford, Conn.
CONCEPTUAL DEVELOPMENT OF STRAIN-GAGE SIGNAL INTERPRETATION SYSTEM FOR JET ENGINE APPLICATIONS Final Report, Feb. 1983 - Mar. 1985
Ray M. Chi, Deborah C. Haas, William C. McClurg, and Philip E. Zwicke Oct. 1985 157 p
(Contract F33615-82-C-2263)
(AD-A165489; UTRC/R85-956394-R1; AFWAL-TR-85-2052) Avail: NTIS HC A08/MF A01 CSCL 21/5

This study sought to define the hardware/software configurations of an expert system capable of monitoring and interpreting strain-gage signals from jet engine compressor stages and immediately taking necessary evasive actions to ensure rig safety. First, a comprehensive strain-gage data bank was generated that contains all major categories of aeromechanical phenomena and noise signals from fan and compressor stages of various engines. These data were analyzed in both time and frequency domains to identify significant signal features for various types of aeromechanical phenomena and noise. These individual signal features were combined with spatial (interblade and interstage), temporal and other syntactic features to form a complete feature set for each aeromechanical phenomenon or noise type. These feature sets were then used in a three level classifier system to determine the probability values of each possible aeromechanical phenomenon and noise type. The first classification uses only the individual strain gage feature to determine the category probability for each phenomena and noise type. The second level uses the spatial features to refine the category pseudo-probability values and yield the event probability values. The third level combines the temporal features with the ev ent probability values to yield the final probabilities based on which decisions are made on the type of actions to be taken to ensure rig safety. GRA

N86-26609# Environmental Research Inst. of Michigan, Ann Arbor.
GRATING INTERFEROMETRIC SENSORS Final Technical Report, 1 Sep. 1982 - 31 Oct. 1985
Anthony M. Tai Feb. 1986 92 p refs
(Contract DAAG29-82-K-0173)
(AD-A165593; ERIM-163700-12-F; ARO-18491.6-PH) Avail: NTIS HC A05/MF A01 CSCL 17/5

A new class of grating-based interferometric sensors is introduced for target discrimination, detection and passive synthetic aperture imaging. It is shown that the grating-based interferometric sensors provide superior system sensitivity and flexibility. Several design approaches and operating modes of the grating interferometric sensors are presented and experiments demonstrating the proposed system concepts are described. We have examined the uses of a grating interferometer for passive synthetic aperture imaging to achieve imaging resolution beyond that permitted by the collection aperture and as a moving target sensor to detect the presence of moving targets that are too small to be resolved. We have shown that the achromaticity of the grating interferometer allows the use of a wider instantaneous spectral bandwidth which in turn provides a better system sensitivity than conventional systems. In addition, the grating interferometer offers a simple means to achieve two-dimensional aperture fill and it is more tolerant to system vibration. GRA

N86-26603# Army Electronics Research and Development Command, Fort Belvoir, Va. Night Vision and Electro-Optics Lab.
IMAGE INTENSIFIERS: PAST AND PRESENT
Robert W. Verona *In* AGARD Visual Protection and Enhancement Dec. 1985 5 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

36 LASERS AND MASERS

Includes parametric amplifiers.

N86-26610# Los Alamos National Lab., N. Mex.
THREE-DIMENSIONAL SIMULATIONS OF AN XUV FREE-ELECTRON LASER
J. C. Goldstein, B. D. McVey, and B. E. Newnam 1985 12 p refs Presented at the International Conference on Insertion Devices for Synchrotron Sources, Stanford, Calif., 27-30 Oct. 1985
(Contract W-7405-eng-36)
(DE86-003654; LA-UR-85-4092; CONF-8510186-4) Avail: NTIS HC A02/MF A01

Operation of free-electron lasers (FEL) at long optical wavelengths (greater than or equal to 600 nm) has now been successfully demonstrated at several laboratories. To operate an FEL at shorter wavelengths imposes constraints on the brightness of the electron beam which are difficult to achieve. Until recently, it was perceived that only an electron storage ring could satisfy these beam requirements. However, our previous 1-D theoretical calculations revealed that modest improvements in the emittance available from rf-linear accelerators would be sufficient to allow operation of an FEL in the XUV spectral range (greater than or equal to 50 nm). We shall present new theoretical results for the design of a linac-driven XUV FEL derived from an improved simulation model. The model is fully three-dimensional in its treatment of the undulator magnetic field, the optical radiation field, and the motion of electrons in a finite-emittance beam. Furthermore, the model computes self-consistently the motion of the electrons and the amplification, diffraction, and the refraction of the light within the undulator magnet. Propagation of the optical beam and reflection at the mirrors of the optical resonator are incorporated in the model so that a complete laser oscillator solution can be generated. The computed performance parameters of a particular XUV FEL oscillator design will be compared with the output of synchrotron radiation sources. DOE

N86-26611# Allied-Signal Corp., Westlake Village, Calif. Military Laser Products Div.
ALEXANDRITE LASERS: STATE OF TECHNOLOGY AND APPLICATIONS
R. C. Sam 1985 9 p Presented at the ICALEO International Congress on the Applications of Lasers and Electro-optics, San Francisco, Calif., Nov. 1985
(Contract W-7405-eng-36)
(DE86-003666; LA-UR-85-4028; CONF-8511103-5) Avail: NTIS HC A02/MF A01

The current alexandrite laser technology will be reviewed. Established applications such as differential absorption LIDAR, nighttime illumination and laser isotope separation will be discussed. Potential new applications will be addressed. DOE

N86-26612# Los Alamos National Lab., N. Mex.
KrF LASERS AS INERTIAL FUSION DRIVERS
D. B. Harris, R. R. Berggren, N. A. Kurnit, D. D. Lowenthal, R. G. Berger, J. M. Eggleston, J. J. Ewing, and M. J. Kushner 1985 37 p Presented at the 11th Symposium on Fusion Engineering, Austin, Tex., 18-28 Nov. 1985 Prepared in cooperation with Spectra Technology, Inc., Bellevue, Wash.
(Contract W-7405-eng-36)
(DE86-003667; LA-UR-85-4019; CONF-851102-34) Avail: NTIS HC A03/MF A01

A new type of KrF laser system has been proposed that has a significantly higher efficiency than pure angular multiplexed KrF lasers. This system uses electron-beam-sustained discharge lasers to pump a high gain Raman amplifier. The discharge lasers can operate at a higher efficiency than e-beam pumped lasers, and the forward Raman scattering process has both a high gain and high quantum efficiency using the rotational transition. The Raman system cost and performance has been examined and compared to the pure angular multiplexed system. The discharge-Raman system has a higher efficiency (12.3% vs 9.1%) and a higher cost ($140/joule vs $100/joule). For an ICF power plant driver, the higher efficiency offsets the higher cost, making the discharge-Raman system appear to be an attractive alternative to the pure angular multiplexed system. DOE

N86-26613# Sandia National Labs., Albuquerque, N. Mex.
TRANSIENT CONDUCTANCE MEASUREMENTS AND HEAT-FLOW ANALYSIS OF PULSED-LASER-INDUCED MELTING OF ALUMINUM THIN FILMS
J. Y. Tsao, S. T. Picraux, P. S. Peercy, and M. O. Thompson 1985 7 p Presented at the Materials Research Society Meeting Prepared in cooperation with Cornell Univ., Ithaca, N.Y.
(Contract DE-AC04-76DP-00789)
(DE86-003928; SAND-85-1397C; CONF-851217-12) Avail: NTIS HC A02/MF A01

We report time-resolved electrical-resistance measurements during pulsed-laser melting of a metal, aluminum. The resistances are correlated with the thresholds for partial and full melting. We describe a semi-analytic solution, based on an impulse-response function, for the response, to a heating pulse, of a thin film of good thermal conductor supported by an infinite substrate. The results agree well with the resistance measurements, and confirm our interpretation of the data. In addition, time-resolved reflectance measurements establishing that, in this geometry, melting and solidification proceed via the motion of a well-defined, planar liquid/solid interface, whose position can be deduced from the resistance measurements. These measurements permit the first real-time determinations of melt-depths and quenching histories during rapid-solidification processing of metals. DOE

N86-26614# Brookhaven National Lab., Upton, N. Y. National Synchrotron Light Source.
TRANSIENT ANALYSIS OF A BUNCHED BEAM FREE ELECTRON LASER
J. M. Wang and L. H. Yu 1985 12 p Presented at the 7th International FEL Conference, Tahoe City, Calif., 8-13 Sep. 1985
(Contract DE-AC02-76CH-00016)
(DE86-003372; BNL-37139; CONF-850956-13) Avail: NTIS HC A02/MF A01

The problem of the bunched beam operation of a free electron laser was studied. Assuming the electron beam to be initially monoenergetic, the Maxwell-Vlasov equations describing the system reduce to a third order partial differential equation for the envelope of the emitted light. The Green's function corresponding to an arbitrary shape of the electron bunch, which describes the transient behavior of the system, is obtained. The Green's function was used to discuss the start up problem as well as the power output and the power spectrum of a self-amplified spontaneous emission. DOE

N86-26615# Lawrence Livermore National Lab., Calif.
HIGH-RESOLUTION ABSORPTION SPECTRUM OF THE 6(1)S0 (YIELDS) 6(3)P1 TRANSITION IN MERCURY WITH A Cw DYE LASER
J. K. Crane, G. V. Erbert, S. D. Mostek, R. C. Kerlin, and J. A. Paisner 13 Nov. 1985 14 p refs Presented at the 1st International Laser Conference, Dallas, Tex., 18-22 Nov. 1985 Submitted for publication
(Contract W-7405-eng-48)
(DE86-003492; UCRL-93471; CONF-851185-2) Avail: NTIS HC A02/MF A01

Using a stabilized single-frequency commercial dye laser and an external cavity doubling crystal, we have measured the isotope shifts of mercury for the 6(1)S0 (YIELDS) 6(3)P1 transition

with an accuracy of 4 MHz. We describe the method for generating single-frequency light at 2537 A and compare the results of measurements of the isotope shifts with previous work. DOE

N86-26616*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A MODEL FOR THE KINETICS OF A SOLAR-PUMPED LONG PATH LASER EXPERIMENT
Larry V. Stock (Hampton Inst., Va.), John W. Wilson, and Russell J. DeYoung May 1986 33 p refs
(Grant NAG1-411)
(NASA-TM-87668; NAS 1.26:87668) Avail: NTIS HC A03/MF A01 CSCL 20E

A kinetic model for a solar-simulator pumped iodine laser system is developed and compared to an experiment in which the solar simulator output is dispersed over a large active volume (150 cu cm) with low simulator light intensity (approx. 200 solar constants). A trace foreign gas which quenches the upper level is introduced into the model. Furthermore, a constant representing optical absorption of the stimulated emission is introduced, in addition to a constant representing the scattering at each of the mirrors, via the optical cavity time constant. The non-uniform heating of the gas is treated as well as the pressure change as a function of time within the cavity. With these new phenomena introduced into the kinetic model, a best reasonable fit to the experimental data is found by adjusting the reaction rate coefficients within the range of known uncertainty by numerical methods giving a new bound within this range of uncertainty. The experimental parameters modeled are the lasing time, laser pulse energy, and time to laser threshold. Author

N86-26617# Los Alamos National Lab., N. Mex.
ELECTRON MICROPULSE DIAGNOSTICS AND RESULTS FOR THE LOS ALAMOS FREE-ELECTRON LASER
W. E. Stein and R. L. Sheffield 1985 19 p refs Presented at the 7th International Free-Electron Laser Conference, Tahoe City, Calif., 8 Sep. 1985
(Contract W-7405-eng-36)
(DE86-003690; LA-UR-85-3167; CONF-850956-14) Avail: NTIS HC A02/MF A01

The electron beam diagnostic used in the Los Alamos free-electron laser are described. These include the standard beam-current,-position and -profile monitors as well as more elaborate energy and temporal spectrometers. Emphasis is given to the latter devices, which provide three-dimensional representations of the electron beam current as a function of energy and time in the picosecond region. These results were used to determine the performance of the accelerator and the laser. Crucial accelerator parameters were the energy spread and temporal shape of the micropulse. Essential laser parameters were the extraction efficiency and the duration of lasing during an individual micropulse. DOE

N86-26618# Xerox Special Information Systems, Pasadena, Calif.
BLUE LASER Final Technical Report, Sep. 1984 - Nov. 1985
Gordon R. Griffin Dec. 1985 33 p
(Contract DACW72-84-C-0016)
(AD-A163201; ETL-0412) Avail: NTIS HC A03/MF A01 CSCL 20/5

This has been a development program to design a low noise, moderate power, blue, hollow cathode laser used for imaging on photoconductors for on-demand color printing. Descriptions of the construction, processing, and testing of experimental unit are presented with recommendations for design improvements. GRA

N86-26619# Naval Research Lab., Washington, D. C.
PROPOSAL FOR FEL EXPERIMENTS DRIVEN BY THE NATIONAL BUREAU OF STANDARDS' CW MICROTRON Memorandum Report, Oct. 1984 - Sep. 1985
Cha-Mei Tang, P. Sprangle, S. Penner, B. M. Kincaid, and R. R. Freeman 31 Dec. 1985 11 p
(AD-A163227; NRL-MR-5709) Avail: NTIS HC A02/MF A01 CSCL 20/5

Free Electron Laser experiments driven by the race-track microtron (RTM) are proposed. The design of RTM has many exceptional properties: (1) normalized transverse emittance of 10 mm mrad, comparable to a storage ring; (2) axial emittance less than 30 keV-degree, much superior to r.f. linacs; (3) electron energy tunable from 20 to approximately 200 MeV; (4) CW operation; (5) energy stability; (6) compactness; and (7) high power-conversion efficiency. Accelerator up-grades to increase the peak current and to recover a significant part of the electron beam energy are also proposed. It seems possible to obtain peak current of I sub p = 5-10A, for electron pulse length of leb greater than approx. 1.2 mm. We have made conservative estimates based on I sub p = 1.0 A in estimating the performance of the FELs to be used with the RTM. Low gain calculations indicate that the FEL can oscillate at the fundamental wavelength ranging from 0.15 to 100 micrometers. Furthermore, we will outline experiments to generate harmonics in the extreme ultraviolet radiation. GRA

N86-26620# Aerospace Corp., El Segundo, Calif.
INITIATOR DURATION EFFECT ON PULSED CHAIN REACTION CHEMICAL LASER SCALING LAWS
Harold Mirels 15 Nov. 1985 52 p
(Contract F04701-85-C-0086)
(AD-A163387; TR-0086(6930-01)-3; SD-TR-85-82) Avail: NTIS HC A04/MF A01 CSCL 20/5

The effect of initiator pulse duration on the performance of a pulsed chain reaction chemical laser is investigated using a two-level vibrational model. Analytic results are presented for a saturated laser in the limits of weak and strong initiation. The initiator is assumed to provide a uniform (e.g., electron beam), parabolic (e.g., flash lamp), or power law variation of F-atom production rate F sub B with time. Laser performance is presented as a function of t sub b/t sub e where t sub B and t sub e are initiator and laser pulse times, respectively. In the weak initiation regime, an increase of t sub B/t sub e from zero to one results in a decrement in laser output energy of 20 and 33-1/3% for a flash lamp and electron-beam initiator, respectively. In the strong initiation regime, an increase of t sub B/t sub e from zero to one results in an energy decrement of only 5 and 10% for a flash lamp and electron-beam initiator, respectively. In each case, the laser pulse time t sub e is increased by a factor of two as t sub B/t sub e increases from zero to one. GRA

N86-26621# Institute for Defense Analyses, Alexandria, Va.
APPLICATIONS OF GAMMA-RAY LASERS Final Partial Report, Apr. - Nov. 1985
Bohdan Balko, Leslie Cohen, and Francis X. Hartmann Nov. 1985 12 p refs
(Contract MDA903-84-C-0031)
(AD-A164889; AD-E500750; IDA-M-141; IDA/HQ-85-30620) Avail: NTIS HC A02/MF A01 CSCL 20/5

As a result of the IST/IDA Gamma-Ray Laser Workshop held in May 1985, a general picture of the gamma-ray laser has emerged. The characteristics of the radiation from this source are contrasted with those from other coherent sources; these include energy, bandwidth, intensity, and coherence length. Potential nonmilitary applications are listed; and two classes of military applications are suggested. Those characteristics which drive a specific application are spelled out. GRA

N86-26622# Institute for Defense Analyses, Alexandria, Va.
IST/IDA (INNOVATIVE SCIENCE AND TECHNOLOGY/ INSTITUTE FOR DEFENSE ANALYSES) GAMMA-RAY LASER WORKSHOP, 21-22 MAY 1985 Final Partial Report, Apr. - Nov. 1985
Bohdan Balko, Leslie Cohen, and Francis X. Hartmann Nov. 1985 26 p refs Workshop held 21-22 May 1985
(Contract MDA903-84-C-0031)
(AD-A164890; AD-E500749; IDA-M-122; IDA/HQ-85-30619) Avail: NTIS HC A03/MF A01 CSCL 20/5

An historical perspective of the gamma-ray laser effect is presented, beginning with the 1957 discovery of the Mossbauer Effect. A retrospective of the workshop is given, including the

principal research workers and laboratories involved. The five principal concepts that emerged and the critical issues attached to each concept are discussed. The conclusions reached as a result of the workshop and the recommendations of the IDA staff for future directions are also presented. GRA

N86-26623# Hampton Inst., Va. Dept. of Physics and Engineering Studies.
A PLASMA ULTRAVIOLET SOURCE FOR SHORT WAVELENGTH LASERS Final Report, 15 Jan. 1985 - 14 Jan. 1986
Kwang S. Han 10 Mar. 1986 28 p
(Grant DAAG29-85-G-0073)
(AD-A165430; ARO-22576.2-PH-H) Avail: NTIS HC A03/MF A01 CSCL 20/5

A high power blue-green laser was pumped with an array of the dense plasma focus. As the result of optimizing the operating conditions of the dense plasma focus and laser system, the maximum untuned laser output exceeded 2.lmJ corresponding to the energy density 3J/cu cm which is much higher than the typical flashlamp dye laser. The optimum operating conditions of the DPF device and laser system were argon pressure 0.3 torr, dye concentration 6 x 0.0001 mol/liter and 10% output transmission mirror. In order to enhance the efficiency of a blue-green laser through spectrum conversion of the pumping light, a converter dye, BBQ, was mixed in the laser dye solutions. The laser was pumped with the hypocyloidal-pinch plasma radiation source. The maximum increase of laser output at the dye mixture of LD490+BBQ or coumarin 503+bbq was about 80%. The enhancement is mainly due to the abundance of near uv in the pumping source, the fairly good match of the fluorescence band of converter dye with the absorption band of the laser dye, and a small overlap of fluorescence band of laser dyes with triplet-triplet adsorption band of converter dye. Author (GRA)

N86-26624# Sandia National Labs., Albuquerque, N. Mex.
SIMPLE WAVEMETER FOR PULSED DYE LASERS
D. Pleasance and R. L. Schmitt Nov. 1985 15 p
(Contract DE-AC04-76DP-00789)
(DE86-004488; SAND-85-8243) Avail: NTIS HC A02/MF A01

A real-time wavemeter has been developed for monitoring the wavelength, linewidth, and pulse energy of flashlamp-pumed dye lasers. The system uses a RETICON photodiode array in the back focal plane of a spectrometer, and is controlled by a versatile, menu-driven computer program. DOE

N86-26625# Lawrence Livermore National Lab., Calif.
VIDEO GUIDEBOOK. PROCEEDINGS OF THE FIRST SYMPOSIUM ON THE APPLICATIONS OF LABORATORY X-RAY LASERS
N. M. Ceglio, ed. 1985 215 p Symposium held at Pacific Grove, Calif., 17-19 Feb. 1985
(Contract W-7405-eng-48)
(DE86-002982; CONF-850293-Absts) Avail: NTIS HC A10/MF A01

On February 17 to 19, 1985 approximately three dozen scientists working in the areas of microbiology, surface and solid state physics, X-ray lithography, plasma physics, short wavelength lasers, and X-ray optics assembled at the Asilomar Conference Center in Pacific Grove, California. Details of microbiology, X-ray holography, and atomic physics were exchanged. There were 15 hours of formal sessions. The overall group was divided into three panels: micromechanics, microbiology, and surface and solid state physics. After a series of X-ray laser briefings given on the morning of February 18, the symposium was turned over to the panels and their chairmen. The proceedings was formed from video tapes of the formal discussions. DOE

N86-26626# Lawrence Livermore National Lab., Calif.
LASER PROGRAM Annual Report, 1984
M. L. Rufer, ed. and P. W. Murphy, ed. Jun. 1985 488 p
(Contract W-7405-eng-48)
(DE86-005297; UCRL-50021-84) Avail: NTIS HC A21/MF A01

The Laser Program Annual Report is part of the continuing series of reports documenting the progress of the unclassified Laser Fusion Program at the Lawrence Livermore National Laboratory (LLNL). As in previous years, the report is organized programmatically. The first section is an overview of the basic goals and directions of the LLNL Inertial Confinement Fusion (ICF) Program, and highlights the year's important accomplishments. Sections 2 through 7 provide the detailed information on the various program elements: Laser Systems and Operations, Target Design, Target Fabrication, Laser Experiments and Advanced Diagnostics, Advanced Laser Development, and Applications of Inertial Confinement Fusion. Individual sections will be indexed separately. DOE

N86-26326# Societe Francaise d'Instruments de Mesure, Velizy-Villacoublay (France). Secteur Capteur Optronique.
USE OF A CO2 LASER LIDAR FOR FLIGHT AND PENETRATION AT VERY LOW ALTITUDES [UTILISATION D'UN LIDAR A LASER CO2 POUR LE VOL ET LA PENETRATION A TRES BASSE ALTITUDE]
Bernard Stephan *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 8 p
(For primary document see N86-26316 17-04)
Avail: NTIS HC A07/MF A01

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N86-26627*# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
SEAM TRACKING PERFORMANCE OF A COAXIAL WELD VISION SYSTEM AND PULSED WELDING Interim Report
K. J. Gangl, J. L. Weeks, and D. Todd Mar. 1986 16 p
(Contract NAS8-27980)
(NASA-CR-178816; NAS 1.26:178816) Avail: NTIS HC A02/MF A01 CSCL 13H

This report describes a continuation of a series of tests on the Coaxial Weld Vision System at MSFC. The ability of the system to compensate for transients associated with pulsed current welding is analyzed. Using the standard image processing approach for root pass seam tracking, the system is also tested for the ability to track the toe of a previous weld bead, for tracking multiple pass weld joints. This Coaxial Weld Vision System was developed by the Ohio State University (OSU) Center for Welding Research and is a part of the Space Shuttle Main Engine Robotic Welding Development System at MSFC. Author

N86-26628*# Quest Engineering Development Corp., Crosby, Tex.
PRESSURE SYSTEMS ENERGY RELEASE PROTECTION (GAS PRESSURIZED SYSTEMS)
Samuel J. Brown, ed. May 1986 435 p refs
(Contract NAS1-17278)
(NASA-CR-178090; NAS 1.26:178090) Avail: NTIS HC A19/MF A01 CSCL 13I

A survey of studies into hazards associated with closed or pressurized system rupture and preliminary guidelines for the performance design of primary, secondary, and protective receptors of these hazards are provided. The hazards discussed in the survey are: blast, fragments, ground motion, heat radiation, biological, and chemical. Performance guidelines for receptors are limited to pressurized systems that contain inert gas. The performance guidelines for protection against the remaining unaddressed degenerative hazards are to be covered in another study. Author

N86-26629*# Garrett Turbine Engine Co., Phoenix, Ariz.
PRELIMINARY EVALUATION OF A COMPOUND CYCLE ENGINE FOR SHIPBOARD GENSETS
Jere G. Castor and William T. Wintucky (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.) Jun. 1986 29 p Sponsored by NASA. Prepared in cooperation with Naval Ship Research and Development Center, Annapolis, Md. Development Center, Annapolis, Md.

(Contract NAS3-24346)
(NASA-CR-179451; NAS 1.26:179451; DTNSRDC-PASD-CR-1856; Garrett-21-5869; AVSCOM-TR-86-C-20) Avail: NTIS HC A03/MF A01 CSCL 13I

The results of a thermodynamic cycle (SFC) and weight analysis performed to establish engine configuration, size, weight and performance are reported. Baseline design configuration was a 2,000 hour MTBO Compound Cycle Engine (CCE) for a helicopter application. The CCE configuration was extrapolated out to a 10,000 MTBO for a shipboard genset application. The study showed that an advanced diesel engine design (CCE) could be substantially lighter and smaller (79% and 82% respectively) than todays contemporary genset diesel engine. Although the CCE was not optimized, it had about a 7% reduction in mission fuel consumption over today's genset diesels. The CCE is a turbocharged, power-compounded, high power density, low-compression ratio diesel engine. Major technology development areas are presented. Author

N86-26630# Admiralty Marine Technology Establishment, Poole (England). Inst. of Sound and Vibration Research.
THE EXAMINATION OF THREE SCUFFING WEAR DISC SPECIMENS FROM UNIVERSITY COLLEGE, CARDIFF
J. Manson Aug. 1985 16 p
(AMTE(M)-TM-85219; BR96848; ESA-86-96848) Avail: Issuing Activity

A metallographic examination of test disk specimens suggests a simple model of scuffing wear. The surface structures and bulk microstructural changes found are consistent with the frictive welding of material at the surface, with a large heat pulse decaying into the bulk material. The results suggest that the initiation of scuffing wear cannot be found on the zone just in front of a scuffed area as the heat pulse generated in the frictive event travels through and changes the prescuffing area. A polish etch effect is the major surface difference between run specimens. ESA

N86-26631# Department of the Air Force, Washington, D.C.
CONTOURED PUNCH TOOL FOR REMOVING SEMI-TUBULAR RIVETS Patent Application
Halver V. Ross, inventor (to Air Force) Filed 10 Jun. 1985 12 p
(AD-D012172; US-Patent-Appl-SN-743326) Avail: NTIS HC A02/MF A01 CSCL 13/5

A rivet removal tool for removing semi-tubular rivets from a work piece is described. The tool has a punch head whose hemispherical tip bottoms within the rivet cavity to provide alignment therewith, and a shoulder whose edge shears the enlarged end of the aligned rivet. GRA

N86-26632# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A CENTRIFUGAL TYPE GASKET FOR BEARINGS
P. D. Kiykov, B. T. Tsoy, and V. A. Brenner 3 Feb. 1986 7 p Transl. into ENGLISH from Russian Patent no. 214984, 29 Mar. 1968 p 1-2
(AD-A164796; FTD-ID(RS)T-0899-85) Avail: NTIS HC A02/MF A01 CSCL 11/1

There is a familiar centrifugal-type gasket for bearings, consisting of an immovable inner ring and an outer rotating ring connected to it, both secured on an axle. The described device differs from the familiar in that the outer and inner rings have joining conical surfaces, flaring in the direction of the outside of the bearing. The inner conical surface of the outer ring is smooth, while the surface of the inner ring joined to it has annular recesses. GRA

N86-26633# Technion Research and Development Foundation Ltd., Haifa (Israel).
MECHANICAL FACE SEAL DYNAMICS Final Report, Jan. 1983 - Aug. 1985
Itzhak Etsion and Itzhak Green Dec. 1985 68 p
(Contract F49620-83-C-0057)
(AD-A164978; EEC-159; AFWAL-TR-85-2082) Avail: NTIS HC A04/MF A01 CSCL 11/1

This report summarizes a three year study of noncontacting coned-face mechanical seal dynamics. Both small perturbation and full nonlinear analyses are presented. An experimental technique to measure relevant dynamic properties of elastomeric secondary seals is described. The critical speed, for the dynamic stability threshold, and the critical rotor runout are presented. It is shown that the more simple to use small perturbation analysis gives very good results for most practical cases. This document includes information on the following form areas: (1) Stiffness and Damping Characteristics of Elastomer O Rings Secondary Seals Subjected to Reciprocating Twist; (2) A Kinematic Model for Mechanical Seals with Antirotation Locks or Positive Drive Devices; (3) Stability Threshold and Steady State Response of Noncontacting Coned-Face Seals; and (4) Nonlinear Dynamic Analysis of Noncontacting Coned-Face Mechanical Seals. GRA

N86-26634# Pennsylvania State Univ., University Park. Applied Research Lab.
ADVANCED PROPULSOR DESIGN STUDIES Final Report
Walter S. Gearhart Jun. 1985 57 p refs
(Contract DTCG23-84-F-20046)
(AD-A164983; USCG-D-1-86) Avail: NTIS HC A04/MF A01 CSCL 13/10

It is the purpose of the propulsor to convert rotational shaft energy into a propulsive thrust. Ideally, this conversion is to be accomplished with the most efficient, vibration-free and inexpensive device. However, emphasis on achieving a particular performance goal such as cavitation resistance, efficiency, or propulsor weight and mechanical simplicity may limit the designer in the type of propulsor configuration to be selected. It is the intent of this document to review the propulsive characteristics of various propulsive types for application on planning hull type craft. On the basis of these studies the performance advantages and shortcomings associated with each type of propulsor will be discussed. The performance of the conventional open propeller as well as propellers employing stationary counterswirl vanes located upstream of the propeller (reaction fin propulsor) shall be reviewed. Ducted propulsors employing a stator blade located upstream of the rotor shall also be considered. GRA

N86-26635# Army Missile Command, Redstone Arsenal, Ala. Guidance and Control Directorate.
THE ANALYSIS, DESIGN AND PERFORMANCE OF A 1.25 INCH DIAMETER PNEUMATIC ACTUATOR
Joe L. Byrd Apr. 1985 66 p refs
(AD-A165297; AD-E950773; AMSMI/RG-85-22-TR) Avail: NTIS HC A04/MF A01 CSCL 13/7

This report presents the detailed design and measured performance of a prototype, single axis vane actuator for potential application to small diameter hypervelocity missiles. The actuator produces over 100 inch-pounds of torque while operating on nitrogen at 1295 psi. The small signal bandwidth is approximately 40 Hz. The actuator operates 2 vanes on a common shaft for aerodynamic control in the pitch or yaw plane. Author (GRA)

N86-26636# Oak Ridge National Lab., Tenn.
DESIGN CONCEPTS AND ADVANCED MANIPULATOR DEVELOPMENT FOR NUCLEAR FUEL CYCLE FACILITIES
M. J. Feldman 1985 24 p Presented at the 1st International Seminar on Nuclear Robotics, Brussels, Belgium, 26 Aug. 1985
(Contract DE-AC05-84OR-21400)
(DE85-01771; CONF-850827-1) Avail: NTIS HC A02/MF A01

In the Fuel Recycle Division, Consolidated Fuel Reprocessing Program at ORNL, a comprehensive remote systems development program has existed for the past seven years. The new remote technology under development is expected to significantly improve remote operations by extending the range of tasks accomplished by remote means and increasing the efficiency of remote work undertaken. The application of advanced manipulation is viewed as an essential part of a series of design directions whose sum describes a somewhat unique blend of old and new technology. A design direction based upon the Teletec concept is

explained and recent progress in the development of an advanced servomanipulator-based maintenance concept is summarized to show that a new generation of remote systems is feasible through advanced technology. DOE

N86-26637# Acurex Corp., Mountain View, Calif. Energy and Environmental Div.
ENVIRONMENTAL ASSESSMENT OF NOx CONTROL ON A COMPRESSION IGNITION LARGE BORE RECIPROCATING INTERNAL COMBUSTION ENGINE. VOLUME 1: TECHNICAL RESULTS Final Report, Apr. 1980 - Apr. 1981
C. Castaldini Jan. 1986 113 p
(Contract EPA-68-02-3188)
(PB86-155819; ACUREX-TR-81-81/EE; EPA-600/7-86-001A) Avail: NTIS HC A06/MF A01 CSCL 21G

Volume 1 of the report gives emission results from field tests of the exhaust gas from a large-bore, compression-ignition reciprocation engine burning diesel fuel. An objective of the tests was to evaluate the operating efficiency of the engine with combustion modification NOx control to reduce emissions to below the proposed NOx new source performance standard (NSPS) of 600 ppm at 15 percent O2 dry. Engine NOx emissions were reduced 31 percent (from 825 to 571 ppm) at 15 percent O2 with 3.5 degrees of fuel injection timing retard. The reduction was accompanied by a 1 percent loss in engine efficiency. CO emissions decreased slightly from 119 to 90 ppm). Total unburned hydrocarbons remained relatively unchanged (25 ppm), as did particulate emissions (35 ng/J) and total organic emissions (55 ng/J). Volatile organics (boiling point less than about 100 C) accounted for the largest fraction of the total organic. Naphthalene, fluoroanthene, phenanthrene/anthracene, and pyrene were the only organic priority pollutants detected in both tests at levels below 70 micrograms/dscm. GRA

N86-26638# National Center for Atmospheric Research, Boulder, Colo.
THREE-LEVEL ENERGY BALANCE CLIMATE MODEL WITH TOPOGRAPHY, EXPLICIT RADIATIVE TRANSFER, AND EXPLICIT SEA ICE AND SNOW MASS BUDGETS Ph.D. Thesis
L. D. D. Harvey 1986 347 p
(Grant NSF ATM-82-17015)
(PB86-181799; NCAR/CT-97) Avail: NTIS HC A15/MF A01 CSCL 03B

A three-level energy balance climate is presented, in which temperatures are computed for the surface, surface air, and stratosphere. The model has land-sea resolution, explicit sea ice and snow mass budgets, and uses a nested integration scheme such that shorter time steps are used for newly forming ice in leads. The sea ice model is found to be very sensitive to the value of many of the input parameters. The effect of adding individual processes can vary dramatically in magnitude from zone to zone and for different seasons. The snowpack sensitivity to changes in model parameters is much less than that of the sea ice model. The full model sensitivity to a solar constant change appears to be dependent on part on the way in which changes in ice mass are partitioned between changes in ice area and in ice thickness. GRA

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N86-26639*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EVALUATION OF MULTILAYER PRINTED WIRING BOARDS BY METALLOGRAPHIC TECHNIQUES: AN ILLUSTRATED GUIDE TO THE PREPARATION AND INSPECTION OF PLATED-THROUGH HOLE TEST COUPONS BASED ON THE REQUIREMENTS OF MIL-P-55110D
Jane Jellison May 1986 72 p refs
(NASA-RP-1161; Rept-86B0088; NAS 1.61:1161) Avail: NTIS HC A04/MF A01 CSCL 14D

This work is an illustrated handbook containing the rationale and procedure for the evaluation of multilayer printed wiring board construction integrity with respect to plated-through holes in accordance with the requirements of MIL-P-55110D, Printed Wiring Boards. It is intended as a practical aid for those concerned with determining the construction integrity of multilayer boards for high reliability applications. Photomicrographs of cross sectioned holes illustrate defect types, acceptable and unacceptable conditions, and methods of measurement. A procedure for specimen preparation is given, and appropriate paragraphs of the military specification are included and explained. Author

N86-26640# George Washington Univ., Washington, D.C. Inst. for Management Science and Engineering.
SEQUENTIAL TESTING AND CONFIDENCE INTERVALS FOR THE MTBF (MEANTIME BETWEEN FAILURES) OF SYSTEMS HAVING EXPONENTIAL DISTRIBUTION OF THE INTERFAILURE TIMES
S. Zacks 23 Dec. 1985 28 p
(Contract N00014-83-K-0216)
(AD-A165189; GWU/IMSE/SERIAL-T-506/85) Avail: NTIS HC A03/MF A01 CSCL 14/2

The application of the Wald SPRT to life testing of equipment, having an exponential distribution of the interfailure times, has been in practice since the 1950s. The problem discussed in the present paper is that of the exact computation of the distributions of the stopping times, and the determination of confidence limits for the mean time between failures (MTBF), theta, after stopping. Formulae are developed for the exact computation of the distribution of stopping times in sequential life testing, according to a modified SPRT. These distributions yield the fractiles of the stopping times at acceptance or at rejection, from which confidence limits for the MTBF can be obtained. GRA

N86-26641# Argonne National Lab., Ill.
EFFECTS OF CAVITATION ON HIGH-CYCLE FATIGUE LIFE
S. Majumdar Sep. 1985 11 p Presented at the Minnowbrook Conference on Life Prediction for High Temperature Gas Turbine Materials, Blue Mountain Lake, N.Y., 27 Aug. 1985
(Contract W-31-109-eng-38)
(DE86-001814; CONF-8508146-1) Avail: NTIS HC A02/MF A01

Cavitation was measured in 304 stainless steel after creep tests. Results show that cavitation is highly inhomogenous. This has a significant effect on the interaction between small amounts of creep damage and high cycle fatigue life. The low cycle creep-fatigue and the high cycle fatigue are not independent and may have large interactive effects. DOE

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N86-26642 ESDU International Ltd., London (England). Engineering Sciences Data Unit.
CIRCULAR-CYLINDRICAL STRUCTURES: DYNAMIC RESPONSE TO VORTEX SHEDDING. PART 3: COMPUTER PROGRAMS
Dec. 1985 25 p refs
(ESDU-85040; ISBN-0-85679-546-1; ISSN-0143-2702) Avail: ESDU

A BASIC program is given for estimating cross wind deflection of cantilever structures such as stacks, towers and process columns or of structural elements held at both ends. The program implements the full procedure developed and presented in ESDU 84038

and predicts both the maximum amplitude (at critical wind speed), and response at off-critical wind speeds. It applies to parallel sided, stepped, and tapered structures and also structures with efficient aerodynamic spoilers. The necessary input data are described and example outputs from program runs are included. A simplified calculation procedure applying to cantilever structures is also given in ESDU 85039. Author

N86-26643# Sandia National Labs., Albuquerque, N. Mex.
RECTANGULAR PLATE IS PROPOSED AS AN IES MODAL TEST STRUCTURE
D. O. Smallwood and D. L. Gregory 1985 10 p Presented at the 4th International Modal Analysis Conference, Los Angeles, Calif., Feb. 1985
(Contract DE-AC04-76DP-00789)
(DE85-018274; SAND-85-2060C; CONF-860224-1) Avail: NTIS HC A02/MF A01

Numerous modal systems are now marketed by commercial companies and new users are continually being introduced to these systems. A simple test structure would be useful to compare these systems on a common basis. The structure would also provide new users with a means to evaluate their newly acquired experimental and analytical skills. This paper will discuss a particular proposed rectangular plate. The physical description of the plate is given, the modal properties of the plate are discussed, and experimental results are given to illustrate the plate behavior. DOE

N86-26644# Shock and Vibration Information Center (Defense), Washington, D. C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 17, NO. 9 Monthly Report
Judith Nagle-Eshleman, ed. Sep. 1985 110 p refs
(AD-A161143) Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20/11

Changing trends in shock and vibration research are noted in this journal. Included are literature surveys, abstracts, current news and editors notes. The feature article is entitled Impactor Interaction with Concrete Structures - Local Effects. For individual titles, see N86-26645 through N86-26646.

N86-26645# Ohio State Univ., Columbus. Dept. of Civil Engineering.
IMPACTOR INTERACTION WITH CONCRETE STRUCTURES: LOCAL EFFECTS
H. Adeli and R. L. Sierakowski *In* SVIC The Shock and Vibration Digest, volume 17, no. 9 Sep. 1985 p 3-16 refs (For primary document see N86-26644 17-39)
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20/11

The local effect of solid impactors acting on concrete structures is studied. Available formulas for predicting the penetration depth, scabbing thickness, and perforation thickness of solid impactors acting on concrete structures are reviewed and compared. Author

N86-26646# Clarkson Univ., Potsdam, N.Y. Dept. of Mechanical and Industrial Engineering.
RECENT RESEARCH IN NONLINEAR ANALYSIS OF BEAMS
M. Sathyamoorthy *In* SVIC The Shock and Vibration Digest, volume 17, no. 9 Sep. 1985 p 19-27 (For primary document see N86-26644 17-39)
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20/11

This literature survey deals with the static and dynamic nonlinear analysis of beams. Also included are papers about arches, cables, frames, strings, and trusses. Papers reviewed are limited to those published between 1982 and 1984. Geometric and material type nonlinearities are included. Analytical, experimental, and numerical methods are reviewed. Author

N86-26647*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
BOUNDARY FORCE METHOD FOR ANALYZING TWO-DIMENSIONAL CRACKED BODIES
P. W. Tan (Analytical Services and Materials, Inc., Hampton, Va.), I. S. Raju, and J. C. Newman, Jr. May 1986 44 p refs
(NASA-TM-87725; NAS 1.15:87725) Avail: NTIS HC A03/MF A01 CSCL 20K

The Boundary Force Method (BFM) was formulated for the two-dimensional stress analysis of complex crack configurations. In this method, only the boundaries of the region of interest are modeled. The boundaries are divided into a finite number of straight-line segments, and at the center of each segment, concentrated forces and a moment are applied. This set of unknown forces and moments is calculated to satisfy the prescribed boundary conditions of the problem. The elasticity solution for the stress distribution due to concentrated forces and a moment applied at an arbitrary point in a cracked infinite plate are used as the fundamental solution. Thus, the crack need not be modeled as part of the boundary. The formulation of the BFM is described and the accuracy of the method is established by analyzing several crack configurations for which accepted stress-intensity factor solutions are known. The crack configurations investigated include mode I and mixed mode (mode I and II) problems. The results obtained are, in general, within + or - 0.5 percent of accurate numerical solutions. The versatility of the method is demonstrated through the analysis of complex crack configurations for which limited or no solutions are known. Author

N86-26648*# Lehigh Univ., Bethlehem, Pa.
THE CRACK PROBLEM IN A REINFORCED CYLINDRICAL SHELL
O. Selcuk Yahsi (Middle East Technical Univ., Ankara, Turkey) and F. Erdogan Mar. 1986 35 p
(Grants NGR39-007-011; NSF MEA-84-14477)
(NASA-CR-176686; NAS 1.26:176686) Avail: NTIS HC A03/MF A01 CSCL 20K

In this paper a partially reinforced cylinder containing an axial through crack is considered. The reinforcement is assumed to be fully bonded to the main cylinder. The composite cylinder is thus modelled by a nonhomogeneous shell having a step change in the elastic properties at the z=0 plane, z being the axial coordinate. Using a Reissner type transverse shear theory the problem is reduced to a pair of singular integral equations. In the special case of a crack tip touching the bimaterial interface it is shown that the dominant parts of the kernels of the integral equations associated with both membrane loading and bending of the shell reduce to the generalized Cauchy kernel obtained for the corresponding plane stress case. The integral equations are solved and the stress intensity factors are given for various crack and shell dimensions. A bonded fiberglass reinforcement which may serve as a crack arrestor is used as an example. Author

N86-26649*# Lehigh Univ., Bethlehem, Pa.
LINE SPRING MODEL AND ITS APPLICATIONS TO PART-THROUGH CRACK PROBLEMS IN PLATES AND SHELLS
F. Erdogan and B. Aksel Jun. 1986 43 p refs
(Grants NGR-39-007-011; NSF MEA-84-14477)
(NASA-CR-176688; NAS 1.26:176688) Avail: NTIS HC A03/MF A01 CSCL 20K

A general description of the line spring model is given. It is extended to cover the problem of interaction of multiple internal and surface cracks in plates and shells. The shape functions for various related crack geometries obtained from the plane strain solution and the results of some multiple crack problems are presented. The problems considered include coplanar surface cracks on the same or opposite sides of a plate, nonsymmetrically located coplanar internal elliptic cracks, and in a very limited way the surface and corner cracks in a plate of finite width and a surface crack in a cylindrical shell with fixed end. Author

N86-26650*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INDEX OF AEROSPACE MECHANISMS SYMPOSIA PROCEEDINGS 1-19
A. Rinaldo (Lockheed Missiles and Space Co., Sunnyvale, Calif.)

and J. Wilson Apr. 1986 281 p
(NASA-TM-88205; A-86076; NAS 1.15:88205) Avail: NTIS HC A13/MF A01 CSCL 13I

This index, organized in five sections (by symposium, by title, by author, by subject, and by project), brings together information on the first 19 Aerospace Mechanisms symposia. Key words are included, cross-referencing all the symposia, and the eighteenth and nineteenth symposia are cross-indexed by project. The Aerospace Mechanisms symposia are devoted to discussions of design, fabrication, test, and operational use of aerospace mechanisms; this is the first index that compiles information on symposia held from 1966 through 1985. Author

N86-26651*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOW-CYCLE THERMAL FATIGUE
Gary R. Halford Feb. 1986 114 p refs
(NASA-TM-87225; E-2890; NAS 1.15:87225) Avail: NTIS HC A06/MF A01 CSCL 20K

A state-of-the-art review is presented of the field of thermal fatigue. Following a brief historical review, the concept is developed that thermal fatigue can be viewed as processes of unbalanced deformation and cracking. The unbalances refer to dissimilar mechanisms occurring in opposing halves of thermal fatigue loading and unloading cycles. Extensive data summaries are presented and results are interpreted in terms of the unbalanced processes involved. Both crack initiation and crack propagation results are summarized. Testing techniques are reviewed, and considerable discussion is given to a technique for thermal fatigue simulation, known as the bithermal fatigue test. Attention is given to the use of isothermal life prediction methods for the prediction of thermal fatigue lives. Shortcomings of isothermally-based life prediction methods are pointed out. Several examples of analyses and thermal fatigue life predictions of high technology structural components are presented. Finally, numerous dos and don'ts relative to design against thermal fatigue are presented. Author

N86-26652*# Battelle Columbus Labs., Ohio.
NONLINEAR DAMAGE ANALYSIS: POSTULATE AND EVALUATION Final Report, 30 Sep. 1981 - 6 Apr. 1983
B. N. Leis and T. P. Forte 6 Apr. 1983 101 p refs
(Contract NAS3-22825)
(NASA-CR-168171; NAS 1.26:168171) Avail: NTIS HC A06/MF A01 CSCL 20K

The objective of this program is to assess the viability of a damage postulate which asserts that the fatigue resistance curve of a metal is history dependent due to inelastic action. The study focusses on OFE copper because this simple model material accentuates the inelastic action central to the damage postulate. Data relevant to damage evolution and crack initiation are developed via a study of surface topography. The effects of surface layer residual stresses are explored via comparative testing as were the effects in initial prestraining. The results of the study very clearly show the deformation history dependence of the fatigue resistance of OFE copper. Furthermore the concept of deformation history dependence is shown to qualitatively explain the fatigue resistance of all histories considered. Likewise quantitative predictions for block cycle histories are found to accurately track the observed results. In this respect the assertion that damage per cycle for a given level of the damage parameter is deformation history dependent appears to be physically justified. Author

N86-26653*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
BUCKLING BEHAVIOR OF RENE 41 TUBULAR PANELS FOR A HYPERSONIC AIRCRAFT WING
William L. Ko, John L. Shideler, and Roger A. Fields May 1986 31 p refs Presented at the AIAA/ASME/ASCE/AHS 27th Structures, Structural Dynamics and Materials Conference, San Antonio, Texas, 19-21 May 1986
(NASA-TM-86798; H-1327; NAS 1.15:86798; AIAA-86-0978) Avail: NTIS HC A03/MF A01 CSCL 20K

The buckling characteristics of Rene 41 tubular panels for a hypersonic aircraft wing were investigated. The panels were repeatedly tested for buckling characteristics using a hypersonic wing test structure and a universal tension/compression testing machine. The nondestructive buckling tests were carried out under different combined load conditions and in different temperature environments. The force/stiffness technique was used to determine the buckling loads of the panel. In spite of some data scattering, resulting from large extrapolations of the data fitting curve (because of the termination of applied loads at relatively low percentages of the buckling loads), the overall test data correlate fairly well with theoretically predicted buckling interaction curves. Also, the structural efficiency of the tubular panels was found to be slightly higher than that of beaded panels. Author

N86-26654# Admiralty Marine Technology Establishment, Dunfermline (Scotland). Inst. of Sound and Vibration Research.
INTERFRAME BUCKLING OF ALUMINIUM ALLOY STIFFENED PLATING
J. D. Clarke, comp., J. W. Swan, comp., and M. Verain Oct. 1985 65 p
(AMTE(S)-R-85104; BR97439; ESA-86-96850) Avail: Issuing Activity

Compression tests on 5 stiffened N8 aluminum alloy plates covering typical full scale warship scantlings are described. The panels were manufactured using normal shipyard production methods to ensure typical initial distortion and residual stresses. Maximum loads and post-buckling load/deflection results are compared with theoretical predictions using a computer program (NI06C). Test results show significant variations in yield strength. In most cases the maximum strength of aluminum alloy structures can be calculated using NI06C with the plating behavior represented by an equivalent steel b/t value giving the same beta. The peak load for sharply varying load/deflection curves may be overestimated. The measured post-buckling strength is higher than that predicted by the simple two half frame finite element model used. This is partly due to the rotational restraint at the frame ends, but could also be due to the additional rotational restraint at the ends provided by the short sections with doubler plates. ESA

N86-26655# New Mexico Univ., Albuquerque.
PROBABILISTIC ANALYSIS OF NONLINEAR STRUCTURES SUBJECTED TO TRANSIENT LOADS. PART 1 Final Report, 15 Nov. 1983 - 30 Nov. 1984
Dennis Morrison Oct. 1985 117 p
(Contract F29601-81-C-0013)
(AD-A163235; NMERI-TA8-81-Pt-1; AFWL-TR-84-154-Pt-1) Avail: NTIS HC A06/MF A01 CSCL 13/13

A technique for the analysis of reliability in linear and nonlinear systems that can be modeled as single-degree-of-freedom (SDF) structures is investigated and established. Transition probabilities are established using conditional probability and problems for stationary and nonstationary input are shown. Methods for computational enhancements are investigated. Multiple point failure analysis of multiple-degree-of-freedom (MDF) systems is addressed separately. Peak responses are expanded in a series involving the input and systems parameters and moments of the peak response are determined. Margins of survival are established using random failure levels and the probability of survival is computed. A second method using the equations of a numerical technique to form the joint probability density of the response measures is also presented. Author (GRA)

N86-26656# Lehigh Univ., Bethlehem, Pa. Inst. of Fracture and Solid Mechanics.
DAMAGE PREDICTION OF PROJECTILE PENETRATION PROCESS BASED ON ENERGY DISSIPATION RATE Final Report, 1 Apr. 1983 - 30 Sep. 1984
G. C. Sih and D. H. Song Aug. 1985 167 p
(Contracts DAAG46-83-K-0158; DA Proj. 8X3-63304-D-215)
(AD-A163268; AMMRC-TR-85-26) Avail: NTIS HC A08/MF A01 CSCL 19/4

The projectile penetration process covers a wide range of failure modes depending on impact velocity, configuration and

material of the projectile and target. This study overcomes previous difficulties in such mathematical descriptions by applying a concept which assumes that material damage occurs nonhomogeneously throughout the target and can be uniquely associated with the rate at which energy is dissipated in a unit volume of material. Introduced as a corollary of the strain energy density theory are the quantities dV/dA and dW/dV which represent, respectively, the rate of change of volume with surface area and the strain energy density function. Together they deterime the energy used to damage a differential area in the projectile penetration process. Orientations of the damage planes form the failure path. A numerical procedure is developed for modeling the material damage process during projectile penetration. The progressive damage pattern for each time increment is exhibited where the elements fail nonhomogeneously. For blunt projectiles impacting relatively hard targets, the conditions for plugging failure are met soon after impact with little radial flow of material. This failure mode is investigated by invoking different assumptions in the state of the failed elements. This model can also treat the phase transformation of solid where shear bands are formed in regions of highly localized energy states. GRA

N86-26657# Army Tank-Automotive Systems Development Center, Warren, Mich.
RESIDUAL STRESS MEASUREMENTS ON M1 TANK WELDMENTS Final Technical Report, 1 Apr. - 30 Sep. 1985
S. B. Catalano 30 Sep. 1985 40 p
(AD-A163330; TACOM-TR-13133) Avail: NTIS HC A03/MF A01 CSCL 19/3

Residual stress levels were measured on four weldment areas of the M1 tank--two on the hull and two on the turret. Measurements were performed on preexisting tanks as well as on current production runs. Two hulls and two turrets of preexisting tanks were measured; three hulls and two turrets of current production runs were measured. Measurements were performed on the weld nugget and heat-affected zones using portable X-ray diffraction equipment. A total of 142 measurements were performed. Only six measurements exhibited tensile residual stresses; the remainder exhibited compressive residual stresses. The highest tensile residual stress observed was 47,000 psi. Weldment areas measured were: race ring to forward glacis; turret roof plate joint; gunner primary sight to frontal slope plate; and side plate to front portion of hull. GRA

N86-26658# Dayton Univ., Ohio.
TWO COMPLIANCE EXPRESSIONS FOR ARBITRARY LOCATIONS ACROSS A CRACK IN A CT (COMPACT TYPE) SPECIMEN Interim Report, Jan. 1984 - Mar. 1985
P. R. Enderle and Noel E. Ashbaugh Jun. 1985 56 p refs
(Contracts F33615-81-C-5015; F33615-84-C-5051)
(AD-A163369; AFWAL-TR-85-4074) Avail: NTIS HC A04/MF A01 CSCL 20/11

Two empirical equations were developed that express displacement across the crack in a compact type specimen as a function of crack length and distance behind the crack tip. The coefficients in the equations were generally determined by least square error fit to crack surface displacements obtained from finite element analysis. In one expression, simple types of functions which depend on either crack length or distance from the crack tip were combined to form an equation that is similar to a series expansion in two separate variables. The second equation was developed from a combination of the far field behavior of the displacements and a near field fit which incorporates the near tip analytical displacement behavior. Both equations have application to a broad range of values of crack length and distance from the crack tip. Either equation can be used in conjunction with measurements of displacement across the crack surface to indirectly determine the crack length. GRA

N86-26659# Dayton Univ., Ohio.
HIGH STRAIN RATE MATERIAL BEHAVIOR Final Report, Aug. 1982 - Sep. 1985
A. M. Rajendran and Stephan J. Bless Dec. 1985 242 p
(Contract F33615-82-C-5126)
(AD-A165214; UDR-TR-84-138; AFWAL-TR-85-4009) Avail: NTIS HC A11/MF A01 CSCL 20/11

High strain rate material behavior of 1020, C1008, HY100 steels, OFHC copper, 7039-T64 aluminum, and BeO was characterized. Data were obtained from split Hopkinson bar (SHB) and plate impact test configurations. A high speed photographic system was used to obtain dynamic stress-strain data from necking Hopkinson bar specimens. The state variable based viscoplastic constitutive model of Bodner and Partom was considered for the material modeling. Computer programs and special purpose subroutines were developed to use the Bodner-Partom model in the STEALTH finite difference code. A unique iterative algorithm was developed to evaluate the model constants from both tensile SHB and plate impact test data. The model constants were determined for the five metals. Both tension and compression SHB and plate impact tests were successfully simulated using Bodner-Partom model constants. GRA

N86-26660# Sandia National Labs., Livermore, Calif.
CRYSTAL PLASTICITY ANALYSIS OF LARGE-STRAIN SHEAR
R. J. Asaro and T. C. Lowe Dec. 1985 26 p
(Contract DE-AC04-76DR-00789)
(DE86-005061; SAND-85-8245) Avail: NTIS HC A03/MF A01

Successful computer prediction of metal forming processes requires accurate constitutive relations to represent large-strain deformation. Crystal plasticity analyses of metal polycrystals subject to large strains are described which will help guide the formulation of such relations. The response of a polycrystalline aggregate of grains is analyzed to elucidate the effects of boundary constraint during large strain shear deformations. Deformation-induced textures are also predicted. Predictions of the Swift effect, that is, normal strains that accompany finite shear strains, are compared with experimental data. DOE

N86-26661# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
THE POSTBUCKLING BEHAVIOR OF BLADE-STIFFENED CARBON EPOXY PANELS LOADED IN COMPRESSION
J. F. M. Wiggenraad 19 Feb. 1985 20 p
(Contracts NIVR-312.2-1019)
(NLR-MP-85019-U; B8577052; ESA-86-96977-L) Avail: NTIS HC A02/MF A01

The postbuckling behavior of blade-stiffened carbon epoxy panel laminates consisting of only a few layers due to the relatively low design loads was studied in compression tests. Certain coupling terms in the stiffness matrices were thought to be no longer insignificant. The full scale panels buckle in a global mode and do not show any postbuckling strength. The short columns, buckling in a local mode, support 1.8 times the initial buckling load before failure. Comparison with calculations shows that the influence of the coupling terms on the buckling behavior of the specimens is relatively small: it decreases the buckling load slightly, does not change the end shortening curves significantly and is mainly apparent in the out-of-plane deflections. ESA

N86-26662# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
SOME TESTS TO ASSESS THE EFFECT OF CRACK STOPPERS ON THE FATIGUE LIFE OF CENTER-NOTCHED SPECIMENS
J. Schijve and F. A. Jacobs Feb. 1984 33 p refs
(NLR-TR-84051-U; B8576224; ESA-86-96981) Avail: NTIS HC A03/MF A01

Crack stoppers were evaluated in crack propagation tests on Alclad 2024-T3 sheet specimens (thickness 2 mm) provided with a central crack to assess the usefulness of very simple crack stopping elements which can be applied to macrocracks in sheet metal structures accessible from one side only. Results show that a stop hole at the crack tip should be filled to obtain a good propping of the hole. Self tapping screws and tapered pins give large crack growth retardation lives. Large retardations are obtained with hard driven rivets and with heavily tightened bolts in the stop holes, but they require accessibility from two sides. Flight-simulation

loading on specimens with tightened bolts indicates a significant retardation, but quantitatively the effects under flight-simulation loading and under constant-amplitude loading are highly different. ESA

N86-26663# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
CONSTANT AMPLITUDE AND FLIGHT SIMULATION OF FATIGUE TESTS ON ADHESIVE BONDED LAP JOINT SPECIMENS OF 2024-T3 SHEET MATERIAL
J. Schijve and F. A. Jacobs 9 Aug. 1984 47 p refs
(Contracts NIVR-1725)
(NLR-TR-84090-U; B8576223; ESA-86-96982) Avail: NTIS HC A03/MF A01

Fatigue tests were carried out on Redux and FM 123/5 bonded specimens at various stress levels, temperatures (RT to 65C) and low and high test frequencies. Type of failure (bond line failure or sheet failure) and the significance of the adhesive squeeze-out for crack nucleation were examined. Results indicate that the fatigue notch effect of a thickness increase as a result of adhesive bonding of sheet material is very small; the effect of secondary bending is more significant. If the bending effect is not excessive (depending on the design) the fatigue strength of a bonded lap joint is high. In flight-simulation tests, bond line failures do not occur even under severe test conditions. The life in flight is highly superior to results for riveted lap joint and a single shear strap joint, while it is of the same order of magnitude found for riveted double-strap joints. ESA

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N86-26664*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
HISTORY MATCHING BY SPLINE APPROXIMATION AND REGULARIZATION IN SINGLE-PHASE AREAL RESERVOIRS Final Report
Tai-yong Lee (California Inst. of Tech., Pasadena), Costas Kravaris (Michigan Univ., Ann Arbor), and John Seinfeld (California Inst. of Tech., Pasadena) Mar. 1986 54 p Submitted for publication
(Contracts NAS1-17070; NAS1-18107)
(NASA-CR-178087; ICASE-86-19; NAS 1.26:178087) Avail: NTIS HC A04/MF A01 CSCL 09B

An automatic history matching algorithm is developed based on bi-cubic spline approximations of permeability and porosity distributions and on the theory of regularization to estimate permeability or porosity in a single-phase, two-dimensional real reservoir from well pressure data. The regularization feature of the algorithm is used to convert the ill-posed history matching problem into a well-posed problem. The algorithm employs the conjugate gradient method as its core minimization method. A number of numerical experiments are carried out to evaluate the performance of the algorithm. Comparisons with conventional (non-regularized) automatic history matching algorithms indicate the superiority of the new algorithm with respect to the parameter estimates obtained. A quasioptimal regularization parameter is determined without requiring a priori information on the statistical properties of the observations. Author

N86-26665*# South Carolina Univ., Columbia. Inst. for Marine Biology and Coastal Research.
APPLICATION OF LANDSAT TM IMAGES TO ASSESS CIRCULATION AND DISPERSION IN COASTAL LAGOONS Progress Report
Bjoern Kjerfve, John R. Jensen, and K. E. Magill 15 Feb. 1986 38 p refs
(Contract NAS5-28741)
(NASA-CR-177315; NAS 1.26:177315) Avail: NTIS HC A03/MF A01 CSCL 08C

The main objectives are formulated around a four pronged work approach, consisting of tasks related to: image processing and analysis of LANDSAT thematic mapping; numerical modeling of circulation and dispersion; hydrographic and spectral radiation field sampling/ground truth data collection; and special efforts to focus the investigation on turbid coastal/estuarine fronts. Author

N86-26666# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
A PROPOSAL FOR A PROJECT ENTITLED ASSESSMENT OF FOREST RESOURCES IN URUGUAY SUBMITTED TO THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION (UNIDO)
Rene Antonio Novaes, David Chung Liang Lee, Pedro Hernandez Filho, Armando PachecodosSantos, and Flavio Jorge Ponzoni Mar. 1986 13 p
(INPE-3828-NTE/255) Avail: NTIS HC A02/MF A01

This project proposal was submitted by request of the United Nations Industrial Development Organization (UNIDO). The main objective is to collect basis forest information for the development, promotion, and utilization of alternative sources of energy through the use of Uruguay's national resources and to define the value of LANDSAT-TM as an aid in efficient management of the country's plantations. An additional objective is to train the Uruguayan technical team. Indications are given as to how each task will be accomplished and what techniques will be employed in performing main tasks such as: forest mapping and development of map legends, map accuracy assessment and forest area correction, stand timber volume evaluation, field sampling, and mensuration procedures. Flow diagrams of the overall project, activity bar diagrams, and list of equipment required for task completion are included. The expected results of the map products and timber volumes are discussed. Author

N86-26667# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
WHEAT AREA ESTIMATION USING DIGITAL LANDSAT MSS DATA AND AERIAL PHOTOGRAPHS
Mauricio A. Moreira, Sherry C. Chen, and Getulio T. Batista Mar. 1986 28 p Submitted for publication
(INPE-3824-PRE/900) Avail: NTIS HC A03/MF A01

A procedure to estimate wheat (Triticum aestivum L) area using sampling technique based on aerial photographs and digital LANDSAT MSS data was developed. Aerial photographs covering 720 sq km were visually analyzed. Computer classification of LANDSAT MSS data acquired on Sept. 4, 1979 was done using unsupervised and supervised algorithms and classification results were spatially filtered using a post-processing technique. To estimate wheat area, a regression approach was applied using different sample sizes and various sampling units. Based on four decision criteria proposed in this study, it was concluded that: (1) as the size of sampling unit decreased, the percentage of sample area required to obtain similar estimation performance also decreased; (2) the lowest percentage of the area sampled for wheat estimation under established precision and accuracy criteria through regression estimation was 13.09% using 10 sq km as the sampling unit; and (3) wheat area estimation obtained by regression estimation was more precise and accurate than those obtained by direct expansion method. Author

N86-26668# National Environmental Satellite Service, Suitland, Md. Satellite Applications Lab.
CHARACTERISTICS OF WESTERN REGION FLASH FLOOD

EVENTS IN GOES IMAGERY AND CONVENTIONAL DATA
Eric L. Fleming and LeRoy E. Spayd, Jr. Mar. 1986 87 p refs (NOAA-TM-NESDIS-13) Avail: NTIS HC A05/MF A01

Characteristics of western region convective and extratropical cyclone flash flood events as observed in (VIS and IR) GOES imagery and conventional surface and upper air data are presented. One hundred and thirty-seven convective heavy rainfall events from 1981 to 1983 were examined and categorized into time of year, time of day of maximum precipitation, minimum cloud top temperature at time of maximum precipitation, and type of satellite-observed convective system. Detailed analysis of conventional data for the largest flash flood producing mesoscale convective systems (MCS) yielded four distinct atmospheric patterns at the surface, 700, and 500 mb levels. Twenty-four flash flood events produced by extratropical cyclones from 1981 to 1983 were classified into three main types of satellite observed cloud patterns. These atmospheric composites and satellite observed cloud patterns were designed to aid operational meteorologists in recognizing and forecasting flash flood events in the western region of the United States. M.G.

N86-26669*# Kansas Univ. Center for Research, Inc., Lawrence. Space Technology Center.
RESEARCH ON ENHANCING THE UTILIZATION OF DIGITAL MULTISPECTRAL DATA AND GEOGRAPHIC INFORMATION SYSTEMS IN GLOBAL HABITABILITY STUDIES Final Report, 1985-1986
Edward A. Martinko and James W. Merchant Feb. 1986 60 p Sponosred in part by the Kansas Fish and Game Commission
(Grant NGL-17-004-024)
(NASA-CR-177294; NAS 1.26:177294) Avail: NTIS HC A04/MF A01 CSCL 05B

The University of Kansas Applied Remote Sensing (KARS) program is engaged in a continuing long term research and development effort designed to reveal and facilitate new applications of remote sensing technology for decision makers in governmental agencies and private firms. Some objectives of the program follows. The development of new modes of analyzing multispectral scanner, aerial camera, thermal scanner, and radar data, singly or in concert in order to more effectively use these systems. Merge data derived from remote sensing with data derived from conventional sources in geographic information systems to facilitate better environmental planning. Stimulation of the application of the products of remote sensing systems to problems of resource management and environmental quality now being addressed in NASA's Global Habitability directive. The application of remote sensing techniques and analysis and geographic information systems technology to the solution of significant concerns of state and local officials and private industry. The guidance, assistance and stimulation of faculty, staff and students in the utilization of information from the Earth Resources Satellite (LANDSAT) and Aircraft Programs of NASA in research, education, and public service activities carried at the University of Kansas. E.R.

N86-26670*# University of South Florida, St. Petersburg. Dept. of Marine Science.
A SIMULATION ANALYSIS OF THE FATE OF PHYTOPLANKTON WITHIN THE MID-ATLANTIC BIGHT
John J. Walsh, Dwight A. Dieterle, and Mark B. Meyers 1986 62 p
(Grant NAGw-678)
(NASA-CR-177265; NAS 1.26:177265) Avail: NTIS HC A04/MF A01 CSCL 08A

A time-dependent, three-dimensional simulation model of wind-induced changes of the circulation field, of light and nutrient regulation of photosynthesis, of vertical mixing as well as algal sinking, and of herbivore grazing stress, is used to analyze the seasonal production, consumption, and transport of the spring bloom within the mid-Atlantic Bight. The particular case (c) of a 58-day period in February-April 1979, simulated primary production, based on both nitrate and recycled nitrogen, with a mean of 0.62 g C sq m/day over the whole model domain, and an export at the shelf-break off Long Island of 2.60 g ch1 sq m/day within the lower third of the water column. About 57% of the carbon fixation was removed by herbivores, with 21% lost as export, either downshelf or offshore to slope waters, after the first 58 days of the spring bloom. Extension of the model for another 22 days of case (c) increased the mean export to 27%, while variation of the model's parameters in 8 other cases led to a range in export from 8% to 38% of the average primary production. Spatial and temporal variations of the simulated albal biomass, left behind in the shelf water column, reproduced chlorophyll fields sensed by satellite, shipboard, and in situ instruments. Author

N86-26671# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
IMPULSE RADAR SOUNDING OF LEVEL FIRST-YEAR SEA ICE FROM AN ICEBREAKER
Carl R. Martinson Nov. 1985 15 p
(AD-A163229; CRREL-SR-85-21) Avail: NTIS HC A02/MF A01 CSCL 08/12

During the weeks of May 1984, a CRREL impulse radar system was used onboard the R V Polarstern to measure the thickness of level first-year sea ice. The purpose was to determine the onboard performance of the radar system and, if possible, provide ice thickness information to researchers conducting other tests. Radar data were compared with ice thickness determined by drilling, indicating that radar soundings could be a viable means of collecting ice thickness information. A lack of adequate coordination between the two measurement methods prevented a point-by-point comparison of ice thicknesses; the comparisons were based on averages for particular test runs. The differences of the averages for the two measuring methods ranged from 0.03 m to 0.22 m with a mean variation in the differences of 0.13 m for eight runs. There may have been some interference from the ship's hull during data collection because of the location of the antenna. However, an unidentified signal in some of the data does not appear to obscure a valid return from the bottom of the ice sheet. Author (GRA)

N86-26672# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
AN ISOSTATIC EARTH MODEL
Hans Suenkel Sep. 1985 59 p refs
(Contract F19628-82-K-0017)
(AD-A164608; OSU/DGSS-367; AFGL-TR-85-0239; SR-10) Avail: NTIS HC A04/MF A01 CSCL 08/5

The concept of the conventional Airy/Heiskanen isostatic model is investigated from scratch, based on the harmonic analysis of the topographic-isostatic potential. First and higher order approximations for those coefficients are discussed and rule of thumb formulas given. The estimated frequency transfer function between the power spectrum of the observed gravitational field and the power spectrum implied by the isostatic model strongly suggests a smoothing of the compensation surface according to Vening Meinesz with a smoothing operator of Gaussian bell-shaped type, and a depth of compensation of about 24 km. A proof of equivalence of using a standard Airy/Heiskanen model with a larger compensation depth and a corresponding Poisson smoothed Vening Meinesz model at a smaller depth has been given for the case of linear approximation, yielding an entirely new interpretation of recent isostatic models. An iterative least-squares process has been designed which provides parameter estimates of that isostatic model in best possible agreement with the observed gravitational potential of the earth. Based on these parameters a set of harmonic coefficients of the topographic-isostatic potential, complete up to degree and order 180 was computed. Several maps of topography-isostasy implied geoidal heights are presented for comparison. GRA

N86-26673# Louisiana State Univ., Baton Rouge. Coastal Ecology Lab.
THE ATCHAFALAYA RIVER DELTA. REPORT 7. ANALYTICAL ANALYSIS OF THE DEVELOPMENT OF THE ATCHAFALAYA RIVER DELTA

Flora C. Wang Sep. 1985 203 p refs
(Contract DACW39-81-C-0004)
(AD-A164931; WES-TR-HL-82-15; Rept-7) Avail: NTIS HC A10/MF A01 CSCL 08/8

The diversion of fresh water and sediments from the Mississippi River to the Atchafalaya River is developing a new delta on the south-central Louisiana coast. The building of this new wetland area has prompted scientific interest in predicting delta evolution. This study reports the analytical prediction of future delta growth based on the theory of turbulent jets that issue from river outlets and discharge into quiescent bays. An integrated form of the hydrodynamics equations of flow continuity and momentum balance, coupled with the advection-diffusion mass transport equation, have been formulated into a two dimensional spatial domain. Closed-form analytical solutions are obtained with the aid of similarity functions for the velocity and sediment concentration profiles. A numerical procedure for estimating the area and volume of deposition of the delta sediments is presented. The results show that the deposited sediment forms a saddle-shaped bottom. Rapid accumulatin of suspended sediment near the river outlet and an abrupt decline of sediment deposition away from the outlet observed. It is concluded that the riverine inflow has a insignificant influence of sediment deposition within a short longitudinal distance, and that beyond that distance the riverine inflow is insignificant. The analytical predictions are compared with the predictions made by other statistical and generic approaches; an agreement is found. Author (GRA)

N86-26674# Institute for Land and Water Management Research, Wageningen (Netherlands). Subfaculteit Wiskunde en Informatica.
A MULTIINDEX MULTITEMPORAL APPROACH TO MAP CROPS IN THE EARLY GROWING SEASON: AN APPLICATION TO TWO ITALIAN IRRIGATION DISTRICTS: EAST SESIA AND GRANDE BONIFIGA FERRARESE
M. Sc. Dott and S. Azzali May 1985 42 p Sponsored by European Economic Commission
(ICW-1611; ESA-86-96955) Avail: NTIS HC A03/MF A01

The feasibility of a method to determine quality, quantity, and type of crops and their water stress by LANDSAT images was tested in two irrigation districts in the Po valley, Italy. In spite of striking misestimates, results are promising, 5 out of 11 crops being detected. However, the uncertain number of yearly available images and lack of reference data to tune the method inhibit the operational development of this tool. It is emphasized that the feasibility of mapping individual crops by means of LANDSAT-MSS data is definitely proven in principle. A semioperational use of such data would provide an opportunity to iron out practical details and assess the amount of needed ancillary and ground-reference data, given the required accuracy of determination. ESA

N86-26675# Geological Survey, Reston, Va. National Mapping Div.
RESEARCH, INVESTIGATIONS AND TECHNICAL DEVELOPMENTS: NATIONAL MAPPING PROGRAM, 1983-1984
R. B. McEwen 1985 134 p
(PB86-166097; USGS-OFR-85-304) Avail: NTIS HC A07/MF A01 CSCL 08B

Subject areas covered are cartography, photogrammetry and surveying, image mapping, remote sensing, land use and land cover mapping, and geographic information systems. The influence of digital cartographic concepts is found throughout and is leading not only to the automation of map making but to the computer analysis of spatial data, the essence of modern geographic information systems. There are several activities of special interest. These include the 1:100,000-scale digital cartographic data base, the LANDSAT Thematic Mapper image map of Great Salt Lake and Vicinity, the successful testing of the Aerial Profiling of Terrain System, several applications of geographic information systems, and publication of the first chapters of the National Gazetteer of the United States. GRA

N86-27168*# Geological Survey, Flagstaff, Ariz.
MAPPING EXPERIMENT WITH SPACE STATION
Sherman S. C. Wu *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p
(For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N86-26676# Battelle Columbus Labs., Ohio.
PROJECT SUMMARIES: SEVENTH BATTERY AND ELECTROCHEMICAL CONTRACTORS' CONFERENCE
Nov. 1985 128 p ref Conf. held at Crystal City, Va., 18-21 Nov. 1985 Prepared in cooperation with Pacific Northwest Labs., Richland, Wash.
(Contract DE-AC06-76RL-01830)
(DE86-003020; CONF-851146-Summ) Avail: NTIS HC A07/MF A01

The overall goal of the United States' energy policy is to foster an adequate supply of energy at a reasonable cost. This policy recognizes that adequate supply requires flexibility in the energy system, with no reliance on any single source of supply. The Energy Storage Program of the Office of Energy Storage and Distribution is supporting this policy by providing the technology base and exploratory development required for the more effective use of electrochemical technologies, aimed at improved energy flexibility in transportation, electric utility, and industrial applications. This document represents a compilation of seventy-four project summaries of research supported by the US Department of Energy, Energy Storage Program. Sections included in this report are: Sodium Sulfur Research and Development, Flow Battery Research and Development, Advanced Battery Research, Systems Analysis, Performance and Testing, Metal Air Batteries, and Fuel Cells.DOE

N86-26677*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NICKEL-HYDROGEN SEPARATOR DEVELOPMENT
Olga D. Gonzalez-Sanabria 1986 8 p refs Presented at the 21st Intersociety Energy Conversion Engineering Conference, San Diego, Calif., 25-29 Aug. 1986; sponsored by the ACS, SAE, ANS, ASME, IEEE, and AICHE
(NASA-TM-87332; E-3076; NAS 1.15:87332) Avail: NTIS HC A02/MF A01 CSCL 10C

The separator technology is a critical element in the nickel-hydrogen (Ni-H2) systems. Previous research and development work carried out at NASA Lewis Research Center has determined that separators made from zirconium oxide (ZrO2) and potassium titanate (PKT) fibers will function satisfactorily in Ni-H2 cells without exhibiting the problems associated with the asbestos separators. These separators and their characteristics were previously discussed. A program was established to transfer the separator technology into a commercial production line. A detailed plan of this program will be presented and the preliminary results will be discussed. Author

N86-26678*# National Aeronautics and Space Administration, Washington, D.C.
SOLAR ENERGY AND THE AERONAUTICS INDUSTRY Thesis
L. Benedek Nov. 1985 74 p refs Transl. into ENGLISH of Argentinian Thesis, 9 Oct. 1985 p 1-82 Transl. by The Corporate Word, Inc., Pittsburgh, Pa.

(Contract NASw-4006)
(NASA-TM-77957; NAS 1.15:77957) Avail: NTIS HC A04/MF A01 CSCL 10B

An introduction to the physical aspects of solar energy, incidental energy and variations in solar flux is presented, along with an explanation of the physical principles of obtaining solar energy. The history of the application of solar energy to aeronautics, including the Gossamer Penguin and the Solar Challenger is given. Finally, an analysis of the possibilities of using a reaction motor with hybrid propulsion combining solar energy with traditional fuels as well as calculations of the proposed cycle and its mode of operation are given. Author

N86-26679*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROCEEDINGS OF THE FLAT-PLATE SOLAR ARRAY PROJECT WORKSHOP ON LOW-COST POLYSILICON FOR TERRESTRIAL PHOTOVOLTAIC SOLAR-CELL APPLICATIONS
Feb. 1986 425 p Workshop held in Las Vegas, Nev., 28-30 Oct. 1985
(Contracts NAS7-918; DE-AI01-85CE-89008)
(NASA-CR-176816; JPL-5101-287; DOE/JPL-1012-122; JPL-Publ-86-11; NAS 1.26:176816) Avail: NTIS HC A18/MF A01 CSCL 10A

Sessions conducted included: polysilicon material requirements; economics; process development in the U.S.; international process development; and polysilicon market and forecasts. Twenty-one papers were presented and discussed. For individual titles, see N86-26680 through N86-26697.

N86-26680*# Westinghouse Research and Development Center, Pittsburgh, Pa.
EFFECTS OF IMPURITIES ON SILICON SOLAR-CELL PERFORMANCE
R. H. Hopkins *In* JPL Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 15-34 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

Model analyses indicate that sophisticated solar cell designs (back surface fields, optical reflectors, surface passivation, and double layer antireflective coatings) can produce devices with conversion efficiencies above 20%. To realize this potential, the quality of the silicon from which the cells are made must be improved; and these excellent electrical properties must be maintained during device processing. As the cell efficiency rises, the sensitivity to trace contaminants also increases. For example, the threshold Ti impurity concentraion at which cell performance degrades is more than an order of magnitude lower for an 18% cell than for a 16% cell. Similar behavior occurs for numerous other metal species which introduce deep level traps that stimulate the recombination of photogenerated carriers in silicon. Purification via crystal growth in conjunction with gettering steps to preserve the large diffusion length of the as grown material can lead to the production of devices with efficiencies above 18%, as verified experimentally. Author

N86-26681*# Illinois Univ., Urbana.
REQUIREMENTS FOR HIGH-EFFICIENCY SOLAR CELLS
C. Tang Sah *In* JPL Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 37-52 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

Minimum recombination and low injection level are essential for high efficiency. Twenty percent AM1 efficiency requires a dark recombination current density of 2 x 10 to the minus 13th power A/sq cm and a recombination center density of less than 10 to the 10th power /cu cm. Recombination mechanisms at thirteen locations in a conventional single crystalline silicon cell design are reviewed. Three additional recombination locations are described at grain boundaries in polycrystalline cells. Material perfection and fabrication process optimization requirements for high efficiency are outlined. Innovative device designs to reduce recombination in the bulk and interfaces of single crystalline cells and in the grain boundary of polycrystalline cells are reviewed. Author

N86-26682*# Osaka Titanium Co. Ltd., Amagasaki (Japan).
ECONOMICS OF POLYSILICON PROCESS: A VIEW FROM JAPAN
Yasuhiro Shimizu *In* JPL Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 57-78 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

The production process of solar grade silicon (SOG-Si) through trichlorosilane (TCS) was researched in a program sponsored by New Energy Development Organization (NEDO). The NEDO process consists of the following two steps: TCS production from by-product silicon tetrachloride (STC) and SOG-Si formation from TCS using a fluidized bed reactor. Based on the data obtained during the research program, the manufacturing cost of the NEDO process and other polysilicon manufacturing processes were compared. The manufacturing cost was calculated on the basis of 1000 tons/year production. The cost estimate showed that the cost of producing silicon by all of the new processes is less than the cost by the conventional Siemens process. Using a new process, the cost of producing semiconductor grade silicon was found to be virtually the same with any to the TCS, dicloro-silane, and monosilane processes when by-products were recycled. The SOG-Si manufacturing processes using the fluidized bed reactor, which needs further development, shows a greater probablility of cost reduction than the filament processes. B.G.

N86-26683*# Lamar Univ., Beaumont, Tex.
ECONOMICS OF POLYSILICON PROCESSES
Carl L. Yaws, K. Y. Li, and S. M. Chou *In* JPL Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 79-121 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

Techniques are being developed to provide lower cost polysilicon material for solar cells. Existing technology which normally provides semiconductor industry polysilicon material is undergoing changes and also being used to provide polysilicon material for solar cells. Economics of new and existing technologies are presented for producing polysilicon. The economics are primarily based on the preliminary process design of a plant producing 1,000 metric tons/year of silicon. The polysilicon processes include: Siemen's process (hydrogen reduction of trichlorosilane); Union Carbide process (silane decomposition); and Hemlock Semiconductor process (hydrogen reduction of dichlorosilane). The economics include cost estimates of capital investment and product cost to produce polysilicon via the technology. Sensitivity analysis results are also presented to disclose the effect of major paramentes such as utilities, labor, raw materials and capital investment. Author

N86-26684*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SENSITIVITY ANALYSIS FOR SOLAR PLATES
Robert W. Aster *In its* Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 123-130 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

Economic evaluation methods and analyses of emerging photovoltaic (PV) technology since 1976 was prepared. This type of analysis was applied to the silicon research portion of the PV Program in order to determine the importance of this research effort in relationship to the successful development of commercial PV systems. All four generic types of PV that use silicon were addressed: crystal ingots grown either by the Czochralski method or an ingot casting method; ribbons pulled directly from molten silicon; an amorphous silicon thin film; and use of high concentration

lenses. Three technologies were analyzed: the Union Carbide fluidized bed reactor process, the Hemlock process, and the Union Carbide Komatsu process. The major components of each process were assessed in terms of the costs of capital equipment, labor, materials, and utilities. These assessments were encoded as the probabilities assigned by experts for achieving various cost values or production rates. B.G.

N86-26685*# Union Carbide Corp., Washougal, Wash.
DEVELOPMENT OF THE SILANE PROCESS FOR THE PRODUCTION OF LOW-COST POLYSILICON
Sridhar K. Iya *In* JPL Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 135-145 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

It was recognized that the traditional hot rod type deposition process for decomposing silane is energy intensive, and a different approach for converting silane to silicon was chosen. A 1200 metric tons/year capacity commercial plant was constructed in Moses Lake, Washington. A fluidized bed processor was chosen as the most promising technology and several encouraging test runs were conducted. This technology continues to be very promising in producing low cost polysilicon. The Union Carbide silane process and the research development on the fluidized bed silane decomposition are discussed. B.G.

N86-26686*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FLUIDIZED-BED DEVELOPMENT AT JPL
G. Hsu *In its* Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 147-165 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

Silicon deposition on silicon seed particles by silane pyrolysis in a fluidized bed reactor (FBR) was investigated as a low cost, high throughput method to produce high purity polysilicon for solar cell applications. The emphasis of the research is fundamental understanding of fluidized bed silicon deposition. The mechanisms involved were modeled as a six-path process: heterogeneous deposition; homogeneous decomposition; coalescence; coagulation; scavenging; and chemical vapor deposition growth on fines. Author

N86-26687*# Washington Univ., St. Louis, Mo.
FLUIDIZED-BED REACTOR MODELING FOR PRODUCTION OF SILICON BY SILANE PYROLYSIS
M. P. Dudukovic, P. A. Ramachandran, and S. Lai *In* JPL Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 167-184 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

An ideal backmixed reactor model (CSTR) and a fluidized bed bubbling reactor model (FBBR) were developed for silane pyrolysis. Silane decomposition is assumed to occur via two pathways: homogeneous decomposition and heterogeneous chemical vapor deposition (CVD). Both models account for homogeneous and heterogeneous silane decomposition, homogeneous nucleation, coagulation and growth by diffusion of fines, scavenging of fines by large particles, elutriation of fines and CVD growth of large seed particles. At present the models do not account for attrition. The preliminary comparison of the model predictions with experimental results shows reasonable agreement. The CSTR model with no adjustable parameter yields a lower bound on fines formed and upper estimate on production rates. The FBBR model overpredicts the formation of fines but could be matched to experimental data by adjusting the unkown jet emulsion exchange efficients. The models clearly indicate that in order to suppress the formation of fines (smoke) good gas-solid contacting in the grid region must be achieved and the formation of the bubbles suppressed. B.G.

N86-26688*# California Inst. of Tech., Pasadena. Engineering and Applied Science Div.
SILICON PRODUCTION IN AN AEROSOL REACTOR
Jin Jwang Wu and Richard C. Flagan *In* JPL Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 187-208 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

An aerosol reactor system was developed in which large particles of silicon can be grown by silane pyrolysis. To grow particles to sizes larger than one micron, vapor deposition must be used to grow a relatively small number of seed particles. Suppression of nucleation is achieved by limiting the rate of gas phase chemical reactions such that the condensible products of the gas phase chemical reactions diffuse to the surface of the seed particles as rapidly as they are produced. This prevents high degrees of supersaturation and runaway nucleation during the growth process. Particles on the order of 10 microns were grown repeatedly with the present aersol reactor. The nucleation controlled aerosol reactor is, therefore, a suitable system for the production of powders that can readily be separated from the gas by aerodynamic means. B.G.

N86-26689*# Osaka Titanium Co. Ltd., Amagasaki (Japan).
PROCESSES AND PROCESS DEVELOPMENT IN JAPAN
Toshio Noda *In* JPL Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 213-231 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

The commercialization of solar power generation necessitates the development of low cost manufacturing method of silicon suitable for solar cells. The manufacturing methods of semiconductor grade silicon (SEG-Si) and the development of solar grade silicon (SOG-Si) in foreign countries was investigated. It was concluded that the most efficient method of developing such materials was the hydrogen reduction process of trichlorosilane (TCS), using a fluidized bed reactor. The low cost reduction of polysilicon requires cost reductions of raw materials, energy, labor, and capital. These conditions were carefully reviewed. The overall conclusion was that a development program should be based on the TCS-FBR process and that the experimental program should be conducted in test facilities capable of producing 10 tons of silicon granules per year. B.G.

N86-26690*# National Tsing Hua Univ., Hsinchu (Taiwan). Dept. of Electrical Engineering.
PROCESSES AND PROCESS DEVELOPMENT
H. L. Hwang *In* JPL Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 233-248 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

Silicon material research in the Republic of China (ROC) parallels its development in the electronic industry. A brief outline of the historical development in ROC silicon material research is given. Emphasis is placed on the recent Silane Project managed by the National Science Council, ROC, including project objectives, task forces, and recent accomplishments. An introduction is also given to industrialization of the key technologies developed in this project. Author

N86-26691*# Heliotronic G.m.b.H., Burghausen (West Germany).
REFINING OF METALLURGICAL-GRADE SILICON
J. Dietl *In* JPL Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 251-265 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

A basic requirement of large scale solar cell fabrication is to provide low cost base material. Unconventional refining of metallurical grade silicon represents one of the most promising ways of silicon meltstock processing. The refining concept is based

on an optimized combination of metallurgical treatments. Commercially available crude silicon, in this sequence, requires a first pyrometallurgical step by slagging, or, alternatively, solvent extraction by aluminum. After grinding and leaching, high purity qualtiy is gained as an advanced stage of refinement. To reach solar grade quality a final pyrometallurgical step is needed: liquid-gas extraction. Author

N86-26692*# Siemens A.G., Munich (West Germany).
SOLAR-GRADE SILICON PREPARED BY CARBOTHERMIC REDUCTION OF SILICA
H. A. Aulich, F.-W. Schulze, H.-P. Urbach, and A. Lerchenberger *In* JPL Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 267-275 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

An advanced carbothermic reduction (ACR) process was developed to produce solar grade (SC) silicon from high purity silica and carbon. Preparation of starting materials and operation of the arc furnace to product high purity silicon is described. Solar cells prepared from single crystal SG-Si had efficiencies of up to 12.3% practically identical to cells made from electronic grade silicon. The ACR process is not in the pilot stage for further evaluation. Author

N86-26693*# Elkem A/S, Kristiansand (Norway).
A METALLURGICAL ROUTE TO SOLAR-GRADE SILICON
Anders Schei *In* JPL Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 279-295 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

The aim of the process is to produce silicon for crystallization into ingots that can be sliced to wafers for processing into photovoltaic cells. If the potential purity can be realized, the silicon will also be applicable for ribbon pulling techniques where the purification during crystallization is negligible. The process consists of several steps: selection and purification of raw materials, carbothermic reduction of silica, ladle treatment, casting, crushing, leaching, and melting. The leaching step is crucial for high purity, and the obtainable purity is determined by the solidification before leaching. The most difficult specifications to fulfill are the low contents of boron, phosphorus, and carbon. Boron and phosphorus can be excluded from the raw materials, but the carbothermic reduction will unavoidably saturate the silicon with carbon at high temperature. During cooling carbon will precipitate as silicon carbide crystals, which will be harmful in solar cells. The cost of this solar silicon will depend strongly on the scale of production. It is as yet premature to give exact figures, but with a scale of some thousand tons per year, the cost will only be a few times the cost of ordinary metallurgical silicon. Author

N86-26694*# Pragma S.p.A., Rome (Italy).
SOLAR SILICON FROM DIRECTIONAL SOLIDIFICATION OF MG SILICON PRODUCED VIA THE SILICON CARBIDE ROUTE
M. Rustioni, D. Margadonna, R. Pirazzi (Samim Abrasivi S.p.A., Domodossola, Italy), and S. Pizzini (Milan Univ., Italy) *In* JPL Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 297-321 Sponsored in part by ENEA (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

A process of metallurgical grade (MG) silicon production is presented which appears particularly suitable for photovoltaic (PV) applications. The MG silicon is prepared in a 240 KVA, three electrode submerged arc furnace, starting from high grade quartz and high purity silicon carbide. The silicon smelted from the arc furnace was shown to be sufficiently pure to be directionally solidified to 10 to 15 kg. After grinding and acid leaching, had a material yield larger than 90%. With a MG silicon feedstock containing 3 ppmw B, 290 ppmw Fe, 190 ppmw Ti, and 170 ppmw Al, blended with 50% of off grade electronic grade (EG) silicon to reconduct the boron content to a concentration acceptable for solar cell fabrication, the 99% of deep level impurities were concentrated in the last 5% of the ingot. Quite remarkably this material has OCV values higher tham 540 mV and no appreciable shorts due to SiC particles. B.G.

N86-26695*# SRI International Corp., Menlo Park, Calif.
CHARACTERIZATION OF SOLAR-GRADE SILICON PRODUCED BY THE SiF4-Na PROCESS
A. Sanjurjo, K. M. Sancier, R. M. Emerson, S. C. Leach, and J. Minahan (Spectrolab, Inc., Sylmar, Calif.) *In* JPL Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 325-343 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

A process was developed for producing low cost solar grade silicon by the reaction between SiF4 gas and sodium metal. The results of the characterization of the silicon are presented. These results include impurity levels, electronic properties of the silicon after crystal growth, and the performance of solar photovoltaic cells fabricated from wafers of the single crystals. The efficiency of the solar cells fabricated from semiconductor silicon and SiF4-Na silicon was the same. Author

N86-26696*# Eagle-Picher Industries, Inc., Miami, Okla.
A SILANE-BASED POLYSILICON PROCESS
Paul E. Grayson and James Jaffe (Allied Corp., Morristown, N.J.) *In* JPL Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 347-365 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

A silane based polysilicon process plant was constructed in Miami, Oklahoma. The processes included: the synthesis of crude silane gas, ultrapurification of the gas, and direct pyrolysis to product silicon. Features of the process provided for direct continuous operation from process feed to final product, without the requirement to store intermediates or even convert the silane to a liquid phase. Semiconductor product quality as analyzed internally was demonstrated by the first integrated operation of the plant. B.G.

N86-26697*# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
SILICON PURIFICATION USING A Cu-Si ALLOY SOURCE
R. C. Powell, P. Tejedor, and J. M. Olson *In* JPL Proceedings of the Flat-Plate Solar Array Project Workshop on Low-Cost Polysilicon for Terrestrial Photovoltaic Solar-Cell Applications Feb. 1986 p 367-377 (For primary document see N86-26679 17-44)
Avail: NTIS HC A18/MF A01 CSCL 10A

Production of 99.9999% pure silicon from 98% pure metallurgical grade (MG) silicon by a vapor transport filtration process (VTP) is described. The VTF process is a cold wall version of an HCl chemical vapor transport technique using a Si:Cu3Si alloy as the silicon source. The concentration, origin, and behavior of the various impurities involved in the process were determined by chemically analyzing alloys of different purity, the slag formed during the alloying process, and the purified silicon. Atomic absorption, emission spectrometry, inductively coupled plasma, spark source mass spectrometry, and secondary ion mass spectroscopy were used for these analyses. The influence of the Cl/H ratio and the deposition temperature on the transport rate was also investigated. Author

N86-26698# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
AN ANALYTICAL METHOD FOR THE DETERMINATION OF SOLAR CELL MODEL PARAMETERS
Ram Kishore Apr. 1986 10 p Submitted for publication (INPE-3852-PRE/916) Avail: NTIS HC A02/MF A01

A method to determine the parameters of an electrotechnical model of the current-voltage characteristics of a solar cell is presented. It is shown that all the parameters can be obtained

analytically from the experimental data by solving a single parameter transcendental equation. Author

N86-26699# Massachusetts Inst. of Tech., Lexington.
LASER-HEATED CVD PROCESS FOR DEPOSITING THIN FILMS FOR LOW-COST SOLAR CELL APPLICATIONS Annual Subcontract Progress Report, 1 Feb. 1984 - 31 May 1985
J. S. Haggerty and D. Adler Nov. 1985 18 p
(Contract DE-AC02-83CH-10093)
(DE85-016887; SERI/STR-211-2831) Avail: NTIS HC A02/MF A01

Significant progress has been made toward using laser-induced chemical vapor deposition (LICVD) of a-Si:H films in photovoltaic (PV) applications. This report describes research in which the investigators accomplished the safety and equipment changes needed for the deposition of doped films; achieved both n- and p-doping by LICVD for the first time; adapted the existing electrical conductivity measurement apparatus to the requirements of doped films; continued investigating the deposition process; characterized the properties of doped and undoped films with an emphasis on properties crucial to the success of the PV project; and fabricated the first solar cells using LICVD material as the intrinsic layer. DOE

N86-26700# Delaware Univ., Newark. Inst. of Energy Conversion.
STABLE, HIGH-EFFICIENCY, CuInSe2 BASED POLYCRYSTALLINE THIN-FILM TANDEM SOLAR CELLS Annual Subcontract Report, 16 Mar. 1984 - 15 Mar. 1985
R. W. Birkmire and J. E. Phillips Nov. 1985 46 p
(Contract DE-AC02-83CH-10093)
(DE85-016893; SERI/STR-211-2804) Avail: NTIS HC A03/MF A01

The goal of this program is a high-efficiency, thin-film tandem solar cell based on CuInSe2. The performance of the (CdZn)S/CuInSe2 component in the tandem has been brought up to an efficiency of well over 10%. Significant improvement in a CdS/CdTe thin-film cell compatible with the tandem design has also been achieved. A number of tandem devices have been made and progress continues on increasing the efficiency of the cells presently being produced. DOE

N86-26701# Ford Aerospace and Communications Corp., Newport Beach, Calif. Aeronutronic Div.
SODIUM-SULFUR BATTERY DEVELOPMENT, PHASE VB Final Report, 1 Oct. 1981 - 28 Feb. 1985
Oct. 1985 106 p
(Contract DE-AT04-79ET-25102)
(DE86-003484; DOE/ET-25102/T1) Avail: NTIS HC A06/MF A01

The program addressed the development of Na/S batteries for stationary energy storage (SES) and electric vehicle (EV) applications, although during Phase VB the EV application was emphasized. Phase VB technical achievements are summarized as follows: cell development, electrolyte development and production, and battery development. DOE

N86-26702# Argonne National Lab., Ill.
TESTING ACTIVITIES AT THE NATIONAL BATTERY TEST LABORATORY
F. Hornstra, W. H. DeLuca, and T. P. Mulcahey 1985 5 p Presented at the Annual Battery and Electrochemical Energy Storage Contractors' Meeting, Washington, D.C., 18 Nov. 1985
(Contract W-31-109-eng-38)
(DE86-004057; CONF-851146-2) Avail: NTIS HC A02/MF A01

The National Battery Test Laboratory (NBTL) is an Argonne National Laboratory facility for testing, evaluating, and studying advanced electric storage batteries. The facility tests batteries developed under Department of Energy programs and from private industry. These include batteries intended for future electric vehicle (EV) propulsion, electric utility load leveling (LL), and solar energy storage. Since becoming operational, the NBTL has evaluated well over 1400 cells (generally in the form of three- to six-cell modules, but up to 140-cell batteries) of various technologies. Performance characterization assessments are conducted under a series of charge/discharge cycles with constant current, constant power, peak power, and computer simulated dynamic load profile conditions. Flexible charging algorithms are provided to accommodate the specific needs of each battery under test. Special studies are conducted to explore and optimize charge procedures, to investigate the impact of unique load demands on battery performance, and to analyze the thermal management requirements of battery systems. DOE

N86-26703# Sandia National Labs., Albuquerque, N. Mex.
STATUS OF ELECTRIC VEHICLE BATTERY DEVELOPMENT AND MANUFACTURING ACTIVITIES OUTSIDE OF THE UNITED STATES
J. H. Swisher Dec. 1985 70 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985
(Contract DE-AC06-76RL-01830)
(DE86-004215; DOE/RL-01830/T40) Avail: NTIS HC A03/MF A01

A study was conducted to summarize and analyze current activities outside of the United States in battery technology for electric vehicles. Emphasis was placed on batteries which are either commercially available now or may be fully developed within the next ten years. The battery systems of greatest interest currently are sodium/sulfur, nickel/iron, zinc/bromine, and advanced lead/acid. The countries with the largest programs are England, Japan, and the Federal Republic of Germany. Performance and cost goals for each system do not vary significantly from one country to another, with the possible exception of the Soviet Union. The number of joint ventures and consortia that have formed in recent years has increased, and international cooperation is now an important feature of current activities in battery technology. US Executive Branch policy is now very supportive of joint ventures. For this and other reasons, organizations in the United States could benefit from increased involvement in cooperative international activities. DOE

N86-26704# Sandia National Labs., Albuquerque, N. Mex.
UPDATE ON THE STRUCTURAL DESIGN OF THE SANDIA 34-M VERTICAL AXIS WIND TURBINE
D. F. Berg and T. D. Ashwill 1986 8 p Presented at the 5th ASME Wind Energy Symposium
(Contract DE-AC04-76DP-00789)
(DE86-004217; SAND-85-2534C; CONF-860218-1) Avail: NTIS HC A02/MF A01

Sandia National Laboratories, as lead Department of Energy (DOE) laboratory for Vertical Axis Wind Turbine (VWAT) technology development in the USA, has been funded by the Wind/Oceans Technologies Division of the DOE to design and build a 34-M research-oriented VAWT. The machine will incorporate step-tapered blades with natural laminar flow blade sections, and will be capable of operating as either a constant rpm or a continuously-variable rpm machine. Design changes in the last year have reduced the predicted blade flatwise mean stresses by 56% and have reduced the rotor weight by 10,400 kg (23,000 lbs.). Flutter and aeroelastic damping analyses have been completed, instrumentation defined, and initial testing plans developed. The long lead time components of the turbine have been ordered, with deliveries to start in March, 1986. First turn of the turbine is planned for October, 1986. DOE

N86-26705# Department of Energy, Morgantown, W. Va. Energy Technology Center.
PROCEEDINGS OF THE SECOND ANNUAL HEAT ENGINES CONTRACTORS MEETING
Aug. 1985 381 p Meeting held in Morgantown, W. Va., 29 Apr. - 1 May 1985
(Contract DE-AC21-85MC-21353)
(DE85-008595; DOE/METC-85-6023; CONF-850429) Avail: NTIS HC A17/MF A01

The Second Annual Heat Engines Contractors Meeting was held April 29 through May 1, 1985, at the Sheraton Lakeview

Resort and Conference Center in Morgantown, West Virginia and was sponsored and hosted by the US Department of Energy (DOE), Office of Fossil Energy, Morgantown Energy Technology Center (METC). The annual meeting provided a forum for the exchange of information between DOE contractors and interested parties, and this year's meeting was attended by 220 individuals from industry, academia, national laboratories, and other governmental agencies. The proceedings have been reproduced from camera-ready manuscripts furnished by the authors. These papers have not been extensively edited. Most of them deal with gas turbines, diesel engines, fuel slurries, and pulverized fuels for these. The latter requires special coal preparation to get low ash fuels. Twenty-eight papers have been entered individually into EDB and ERA. DOE

N86-26706# Rockwell International Corp., Canoga Park, Calif.
HIGH TEMPERATURE MOLTEN SALT STORAGE Final Subcontract Report
J. Ives, J. C. Newcomb, and A. G. Pard Oct. 1985 95 p
(Contract DE-AC02-83CH-10093)
(DE85-016874; SERI/STR-231-2836) Avail: NTIS HC A05/MF A01

The design of a high-temperature molten salt thermal energy storage (TES) concept, including some materials testing, was developed by Rockwell International's Rocketdyne Division (RD), under contract to SERI, and is described in this document. The main features of the concept are a conical hot tank with a liner and internal insulation that allows unrestricted relative thermal expansion and the use of cathodic protection (impressed voltage) to inhibit corrosion. The RD design uses two tanks and ternary eutectic lithium-sodium-potassium carbonates for sensible heat storage. The tanks were sized for 6 h of storage at a discharge rate of 300 MW, giving 1800 MWh total usable thermal storage capacity. The molten carbonate storage medium is cycled between 425 and 900C. From the design study, no definitive statement can be made as to the cost-effectiveness of cathodic protection. Several anode design issues need to be resolved before cathodic protection can significantly reduce corrosion where the liner comes in contact with molten salts. However, where the tank is exposed to salt vapor, the large corrosion allowance required for the liner without cathodic protection results in a much thicker liner wall and shorter liner life than originally perceived, which affects system costs significantly. DOE

N86-26707# Spire Corp., Bedford, Mass.
RESEARCH ON HIGH-EFFICIENCY, STACKED, MULTIJUNCTION, AMORPHOUS SILICON ALLOY THIN-FILM SOLAR CELLS Semiannual Subcontract Progress Report, 1 Oct. 1983 - 15 May 1985
V. Dalal Nov. 1985 59 p
(Contract DE-AC02-83CH-10093)
(DE85-016875; SERI/STR-211-2845) Avail: NTIS HC A04/MF A01

This technical progress report to the Solar Energy Research Institute covers work on high-efficiency, stacked, multijunction amorphous silicon alloy thin-film solar cells. Material growth was begun in a multisector reactor. The a-Si:H films grown in this reactor were very high quality, as shown in their high ratio of photo-to-dark conductivity and very low dark conductivity. High-band-gap a-Si:H films were achieved by using H etching of films during growth. H2 dilution in the plasma led to a sharpening of the valence band tail in both a-Si:H and a-(Si,Ge):H films. No SiH2 bonds were observed after Ge was added to the a-Si:H. Experiments were begun to develop a two-level, stable back contact to a-Si:H. Preliminary results indicate that a Cr/Pd contact may be stable and moderately reflecting, but the best reflection was obtained with Ag. Mo appears to be a suitable, stable contact to SnO2. A critical parameter in achieving 8.5% efficient a-Si:H devices was plasma-cleaning between deposition of the p- and i-layers. 6.5% efficient a-(Si,Ge):H devices were also grown. Two types of tandem cells were fabricated. DOE

N86-26708# Midwest Research Inst., Golden, Colo.
SOLAR ENERGY COMPUTER MODELS DIRECTORY
Aug. 1985 137 p
(Contract DE-AC02-83CH-10093)
(DE85-008791; SERI/SP-271-2589) Avail: NTIS HC A07/MF A01

This directory describes models developed and available in the US for six solar and renewable energy technologies. These technologies are: biomass; solar heating, cooling, and conservation; ocean energy; photovoltaics; solar thermal; and wind. DOE

N86-26709# Sandia National Labs., Livermore, Calif.
NUMERICAL MODELING OF A SOLID PARTICLE SOLAR CENTRAL RECEIVER
G. H. Evans, W. G. Houf, R. Greif, and C. Crowe Dec. 1985 63 p Prepared in cooperation with California Univ., Berkeley and Washington State Univ., Pullman
(Contract DE-AC04-76DR-00789)
(DE86-005066; SAND-85-8249) Avail: NTIS HC A04/MF A01

The flow of air and particles and the heat transfer inside a solar heated, open cavity containing a falling cloud of 100 to 1000 micron solid particles have been studied. Two-way momentum and thermal coupling between the particles and the air is included in the analysis along with the effects of radiative transport within the particle cloud, among the cavity surfaces, and between the cloud and the surfaces. The flow field is assumed to be two dimensional with steady mean quantities. The PSI-Cell (Particle Source In cell) computer code is used to describe the gas-particle interaction. The method of discrete ordinates is used to obtain the radiative transfer within the cloud. The results include the velocity and temperature profiles of the particles and the air. In addition, the thermal performance of the solid particle solar receiver has been determined as a function of the following particle parameters: size, mass flow rate, absorptivity, and infrared scattering albedo. Other parameters which have been varied include the incident solar flux (both magnitude and distribution) and receiver size. A forced flow, applied across the cavity aperture, has also been investigated as a means of decreasing convective heat loss from the cavity. Comparison of the results from the model has been made with an experiment performed at the radiant heat facility in Albuquerque. The model has also been used to predict the entrainment of air and the decrease in particle drag which has been observed when measurements were made of particle velocity in a cloud of particles in free fall. DOE

N86-26710# Erno Raumfahrttechnik G.m.b.H., Bremen (West Germany). Inst. of Sound and Vibration Research.
ADVANCED HEATING FACILITIES. DEVELOPMENT OF DEMONSTRATION MODELS Final Report
J. Schawer, comp., O. Brost, comp. (Stuttgart Univ., West Germany), G. Blersch, S. Ranke (Leybold-Heraeus G.m.b.H., Hanau/Main, West Germany), and R. Becker (Johann-Wolfgang-Goethe-Univ., Frankfurt am Main, West Germany) Paris ESA Aug. 1985 158 p Presented at EC-5 Intern. Workshop on Electron Cyclotron Emission and Electron Cyclotron Heating and Gyrotron User/Developer Meeting, San Diego, Calif., 9-12 Nov. 1985
(ERNO-671-AHF/2; ESA-CR(P)-2156; ESA-86-96858) Avail: NTIS HC A08/MF A01

Electron beam and heat pipe technique furnaces for spaceborne microgravity experiments were assessed. Testing of demonstration model furnaces clearly shows the advantages of the heat pipe principle for an isothermal furnace. Isothermality of the whole furnace working space can be provided without additional heaters for compensation of the working space end heat losses. Temperature stability during long-time furnace operation can be achieved by using a variable conductance heat pipe (VCHP) with gas pressure feedback-control. The VCHP principle with gas pressure measurement provides a viable method to improve the temperature measurement accuracy, for absolute temperature measurement, and provides long-time accuracy of the temperature measurement. The furnace can be operated at least in a temperature range of 900 to 1500 C. ESA

N86-26711# AEG-Telefunken, Wedel (West Germany).
GROWTH CAPABILITIES OF EUROPEAN RETRACTABLE SOLAR ARRAYS Final Report
G. Behrens Paris, France ESA Jun. 1985 89 p
(Contract ESTEC-5554/83-NL-PB(SC))
(ESA-CR(P)-2141; ESA-86-96870) Avail: NTIS HC A05/MF A01

The growth capabilities of the Advanced Rigid Array, Rigid Solar Generator, L-Sat solar array, SOLA solar array, Space Telescope solar array, and the Ultralight Panel array were assessed. Capabilities of up to 18kW are needed for the NASA manned space station. The assessment shows that each of the arrays can reach the required power range, but without taking economic factors into account, and given that only the existing application was considered, it is not possible to recommend any particular concept. ESA

N86-26712# National Bureau of Standards, Gaithersburg, Md. Building Equipment Div.
MODELING OF A HEAT PUMP CHARGED WITH A NON-AZEOTROPIC REFRIGERANT MIXTURE Final Report
P. Domanski Jan. 1986 396 p Sponsored by EPRI
(PB86-168267; NBS-TN-1218) Avail: NTIS HC A17/MF A01; also available SOD HC $18.00 as SN003-003-02716-2 CSCL 13A

An analysis of the vapor compression cycle and the main components of an air-to-air heat pump charged with a binary non-azeotropic mixture has been performed for steady-state operation. The general heat pump simulation model HPBI has been formulated which is based on independent, analytical models of system components and the logic linking them together. The logic of the program requires an iterative solution of refrigerant pressure and enthalpy balances, and refrigerant mixture and individual mixture component mass inventories. The modeling effort emphasis was on the local thermodynamic phenomena which were described by fundamental heat transfer equations and equation of state relationships among material properties. In the compressor model several refrigerant locations were identified and the processes taking place between these locations accounted for all significant heat and pressure losses. GRA

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N86-26713# Argonne National Lab., Ill.
BIOCHEMICAL TRANSFORMATIONS IN TWO PLANT/SOIL SYSTEMS EXPOSED TO SIMULATED ACIDIC PRECIPITATION
P. M. Irving 1985 24 p Presented at the 7th International Symposium on Environmental Biochemistry, Rome, Italy
(Contract W-31-109-eng-38)
(DE86-004040; CONF-8509211-1) Avail: NTIS HC A02/MF A01

We were interested in determining how normal deposition rates of acidic rain affect the cycling of nutrients in two minimally managed perennial forage-soil systems. The objectives of our research were to quantify the impacts of acidic rain on the plant-soil system, through process-oriented studies of the soil biota, and through examination of the relationships between soil and plants. Our approach was to measure biogeochemical interactions within two sensitive model ecosystems exposed to different doses of simulated acidic rain during a two-year period. The results presented here are a summary of some of the highlights of our investigations. Although the complete picture of ecosystem reponse cannot be reported here, we include a selection of information on treatment effects ranging from chemical and biological processes to population and production dynamics. DOE

N86-26714# Federal Aviation Administration, Washington, D.C. Office of Environment and Energy.
A MICROCOMPUTER POLLUTION MODEL FOR CIVILIAN AIRPORTS AND AIR FORCE BASES
H. M. Segal, J. K. Kemp, and P. L. Hamilton Dec. 1985 55 p
(AD-A163232; FAA-EE-85-4; AFESC/ESL-TR-85-41) Avail: NTIS HC A04/MF A01 CSCL 09/2

Over the past five years, the Federal Aviation Administration and the United States Air Force have developed a number of user-friendly emissions and dispersion models for air quality assessment purposes. The first, Simplex A was completed in July 1981. The second, called Emissions and Dispersion Modeling System (EDMS), has just been completed and this report constitutes its User's Guide. First, this User's Guide shows how the EDMS system evolved from the earlier, more complex AVAP and AQAM systems. Then, it identifies the hardware and software required to run the system and provides instructions on how to add, delete or change standard information. Finally, through a 125-step example problem, it instructs the user on how to input and process data to produce: (1) an emissions inventory of all sources at an airport/airbase, and (2) an estimate of the concentrations of these sources at specified locations. An inexperienced user should be able to process the example problem in less than three hours. Author (GRA)

N86-26715# Air Force Engineering and Services Center, Tyndall AFB, Fla. Engineering and Services Lab.
AIRCRAFT ENGINE EMISSIONS ESTIMATOR Final Report, Jan. 1983 - Sep. 1985
Glenn D. Seitchek Nov. 1985 101 p refs
(AD-A164552; AFESC/ESL-TR-85-14) Avail: NTIS HC A06/MF A01 CSCL 21/5

The objective of this effort is to revise the Aircraft Emission Estimation Techniques (ACEE) Handbook to reflect changes in the Air Force aircraft inventory that have occurred since 1975. A complete listing of current Air Force aircraft and their associated engines is included. Emission factors for most of these engines are provided, along with examples for calculating emissions from aircraft operations, and analyzing their impact. This report supersedes CEEDO-TR-78-33, Aircraft Emission Estimation Techniques (ACEE). Author (GRA)

N86-26716# Coast Guard, Washington, D.C.
A REVIEW OF METHODS TO TRACK OIL IN ARCTIC WATERS Final Report
Joseph W. St.Martin Jun. 1985 25 p refs
(AD-A164679; USCG-D-28-85) Avail: NTIS HC A02/MF A01 CSCL 13/2

A review of available literature on the tracking of oil in Arctic environments was conducted. The effectiveness of satellite and aircraft mounted detection devices used in locating oil-on-water, ice or in an ice/water mixture was examined. Oil spill tracking buoys and devices, both micro and macro scale, were also reviewed with their applicability to the Arctic environment detailed. Recommendations were made for the U.S. Coast Guard to use ARGOS system buoys on Arctic oil spills for long term tracking of movement. An additional recommendation was made for the future testing of the HU-25A mounted AIREYE surveillance system or an HC-130 mounted sensor package on oil spilled in an Arctic environment. Author (GRA)

N86-26717# Corps of Engineers, Davis, Calif. Hydrologic Engineering Center.
HEC-5Q: SYSTEM WATER QUALITY MODELING
R. G. Willey Jan. 1986 23 p
(AD-A164832; HEC-TP-111) Avail: NTIS HC A02/MF A01 CSCL 13/2

Several state-of-the art models are available for analyzing water quality conditions in complex reservoir systems for a given set of operational conditions. Some of these models can even make operational decisions regarding proper gate regulations to obtain a desirable water quality condition at a dam site for a given set of flow conditions. HEC-5Q, Simulation of Flood Control and Conservation Systems (including Water Quality Analysis) computer model, has the unique capabilities to accept user-specified water quantity and quality needs system-wide and to decide how to regulate the network of reservoirs. The decision criteria are programmed to consider flood control, hydropower, instream flow

(municipal, industrial, irrigation, water supply, fish habitat) and water quality requirements. The HEC-5Q program was first applied to the Sacramento River System in California and a report was published in July 1985. Two other applications are in progress in the Kanawha and Monongahela River systems, and are expected to be completed by September 1986. GRA

N86-26718# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.

GAS EXCHANGE BETWEEN THE FOREST AND THE ATMOSPHERE

C. E. Murphy, Jr. 1985 36 p Presented at the Department of Energy (DOE) Meterology Workshop, Lake Placid, N.Y., 1 Oct. 1985

(Contract DE-AC09-76SR-00001)

(DE86-004624; DP-MS-85-116; CONF-8510250-1) Avail: NTIS HC A03/MF A01

Forest gas exchange is discussed in terms of the processes that control the rate of exchange with the atmosphere. Examples are presented to show how vegetative uptake control is varied for gases with different characteristics. The prediction of uptake for large areas and over long periods of time is discussed in terms of quantitative models of the gas exchange processes. Finally, remote sensing is suggested as a means of obtaining the parameters needed to make the model predictions. DOE

N86-26719# Kema N.V., Arnhem (Netherlands). Dept. of Chemical Research.

SELECTIVE CATALYTIC REMOVAL OF NO FROM STATIONARY SOURCES

F. J. J. G. Janssen, F. M. G. vandenKerkhof, and A. J. vanLoon, ed. 1985 19 p

(S/T-Rept-Vol-3-No-6; B8574251; ISBN-90-353-0029-7; ISSN-0167-8590; ESA-86-96945) Avail: NTIS HC A02/MF A01

Research on selective catalytic removal of nitric oxide with ammonia to develop catalysts for use under conditions likely to produce flue gases was surveyed. The activity and selectivity of supported vanadium, tungsten, and iron oxide catalysts were studied in a plug-flow and a mixed-flow reactor on a laboratory scale between 370 and 670 K. The effects of the NO/NH3 ratio, space-velocity and oxygen on the reduction reactions, and effects of catalysts on ammonia and sulfur dioxide oxidation were investigated. The catalysts were characterized by conventional techniques. All the catalysts showed relatively high NO conversion. Data show that the NO/NH3 reaction in the presence of oxygen below 575 K is according to the formula 4 NO + 4 NH3 + O2 yields 4N2 + 6 H2O. Selectivity decreases above 625 K because of NH3 oxidation. The rate of the NO/NH3 reaction on the catalysts under dilute gas conditions is markedly increased by the addition of 1% oxygen. ESA

N86-26720# Environmental Protection Agency, Washington, D.C. Criteria and Standards Div.

NONPOINT SOURCE POLLUTION: INFORMATION GUIDE Final Report, Jan. 1983 - Aug. 1985

P. E. Shelley Aug. 1985 245 p

(PB86-130275) Avail: NTIS HC A11/MF A01 CSCL 13B

Identified are eight Federal agencies, and several sub-units within each of them, involved in environmental impacts of nonpoint source pollution. Complete mail addresses and telephone numbers are included for each organizational unit, along with a brief description of the specific area of concern. This resource will be of value in directing specific questions on nonpoint source pollution to the appropriate agency. GRA

N86-26721# Maryland Univ., College Park. Water Resources Research Center.

MARYLAND WATER RESOURCES RESEARCH CENTER, FISCAL YEAR 1984 PROGRAM REPORT

Sep. 1985 28 p Sponsored in part by the Geological Survey, Reston, Va.

(Grant DI-14-08-0001-G-911)

(PB86-133253; USGS-G-911-01) Avail: NTIS HC A03/MF A01 CSCL 13B

Within the framework of the 1984 Program of the Maryland Water Resources Research Center, three projects were focused on questions of pollution of surface and ground water and one on acid rain. An information transfer project focused on the protection of ground water supplies. In a project to assess nitrogen and phosphorus losses via subsurface ground water flow from conventional and no-till corn watersheds, evidence was obtained that the leaching of nitrates into percolate or ground water is not enhanced by the use of no-till cultivation. No phosphate was found in percolate samples from either no-till or conventional cultivation treatments. A two-year study has been conducted to assess the accumulation of toxic metals in the sediments of Maryland's Eastern Shore rivers. In a project to determine the impact on human health of contaminants present in sludge applied as soil amendment, ground and surface water have been analyzed for mutagenic compounds. Preliminary information on acidity in rainfall indicates increased levels of H(+), SO4(2-), Pb, and Mn over a control area in Tennessee. GRA

N86-26722# Environmental Protection Agency, Research Triangle Park, N.C. Atmospheric Sciences Research Lab.

USER-FRIENDLY SCREENING MODEL FOR POINT-SOURCE IMPACT ASSESSMENT

D. B. Turner Apr. 1986 19 p

(PB86-176369; EPA-600/D086-062) Avail: NTIS HC A02/MF A01 CSCL 04A

A user friendly air quality simulation screening model coded in FORTRAN is described and sample use is shown for point source impact assessment. The model was developed and tested on a personal computer and can be run interactively on a mainframe. Any of five dispersion techniques: (1) wind fluctuations, (2) Briggs urban, (3) Briggs rural, (4) Pasquill-Gifford, or (5) Brookhaven can be used. Plume rise can be calculated either by Briggs 1975 techniques, currently included in models used for regulatory purposes, or by techniques which calculate plume rise layer-by-layer and consider partial penetration. Maximum ground level concentration downwind or concentrations at specific locations can be estimated. Receptor locations can be specified in four ways: (1) specific downwind distance, (2) downwind and crosswind location, (3) distance and azimuth from the source, or (4) Cartesian coordinates of both source and receptor. The model provides ground level estimates for a single stack or ground level source. GRA

N86-26723 Colorado Univ., Boulder.

A STUDY OF THE UNSTEADY AERODYNAMIC FORCES GENERATED BY A DEFORMING JOUKOWSKI AIRFOIL Ph.D. Thesis

John Hugh Russell 1985 150 p

Avail: Univ. Microfilms DA8528520

An analytic study is performed in order to determine the aerodynamic forces that arise from the prescribed deformations of a Joukowski airfoil. The fluid medium is assumed to be an incompressible, potential flow and the superposition principle is used to build the entire flow field. Unsteadiness enters the analysis only through the time dependent body deformations and through the action of the trailing wake. The analysis proceeds in order of increasing difficulty through the construction of the computational model to its application on the general Joukowski airfoil. In all instances evaluated, a degree of unsteady lift enhancement or decrement was observed, depending upon the particular deformation and deformation rate. The study also makes use of a special form of the Blasius Theorem in order to facilitate determination of the aerodynamic forces in a moving reference frame. The unsteady forces are determined by means of a computer code that calculates the time history of the lift and drag arising from the airfoil deformations. The code also computes the effects that the deforming airfoil and the wake have upon each other.

Dissert. Abstr.

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N86-26724*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

DETERMINATION OF BAND OSCILLATOR STRENGTHS OF ATMOSPHERIC MOLECULES FROM HIGH RESOLUTION VACUUM ULTRAVIOLET CROSS SECTION MEASUREMENTS Semiannual Status Report, 1 Nov. 1985 - 30 Apr. 1986

W. H. Parkinson May 1986 69 p refs

(Grant NAG5-484)

(NASA-CR-177293; NAS 1.26:177293; SASR-3) Avail: NTIS HC A04/MF A01 CSCL 04A

An account is given of progress in work on (1) the determination of band oscillator strengths of the Schumann-Runge absorption bands of (16)O2 and (18)O2 from cross section measurements conducted at 79 K; (2) the determination of the absolute absorption cross section of the Schumann-Runge bands of (16)O(18)O from optical depth measurements performed on mixtures of (16)O2, (18)O2 and (16)O(18)O at 79K; and (3) the influence of Schumann-Runge linewing contributions on the determination of the Herzberg continuum absorption cross section of (16)O2 in the wavelength region 194 to 204 nm. The experimental investigations are effected at high resolution with a 6.65 m scanning spectrometer which is, by virtue of its small instrumental width (EWHM = 0.0013 nm), uniquely suitable for cross section measurements of molecular bands with discrete rotational structure. Absolute cross sections, which are independent of the instrumental function and from which band oscillator strengths are directly determined, are measured for the absorption bands that are most predissociated. Such measurements are needed for (1) accurate calculations of the stratospheric production of atomic oxygen and heavy ozone formed following the photopredissociation of (18)O(16)O by solar radiation penetrating between the absorption lines of (16)O2; (2) elucidation of the mechanism of predissociation of the upper state of the Schumann-Runge bands; and (3) determination of the true shape of the Herzberg continuum cross section. Author

N86-26725*# International Council of Scientific Unions, Urbana, Ill.

MIDDLE ATMOSPHERE PROGRAM. HANDBOOK FOR MAP, VOLUME 19

Richard A. Goldberg, ed. (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.) Mar. 1986 210 p

(NASA Order W-15897)

(NASA-CR-176800; NAS 1.26:176800; MAP-HANDBOOK-19) Avail: NTIS HC A10/MF A01; also available from SCOSTEP Secretariat, University of Illinois, 1406 West Green Street, Urbana, Ill. 61801 CSCL 04A

This MAP handbook is concerned with rocket techniques and instrumentation as they are currently employed in the middle atmosphere. It is composed of nine chapters, written by experts on rocket experiments. The emphasis is on measurement techniques rather than results, although results are incorporated wherever they provide examples which illustrate the measurement features. The chapters first cover techniques relating to measurements of neutral dynamics and chemistry, then measurements of the various intermittent and excessive radiation sources which effect the middle atmospheric environment, and finally measurements of the plasma environment including electric fields. The weighting toward plasma related parameters is not accidental, but reflects both the historical headstart given by early development of radio wave and probe techniques to measure electron density, and by the relatively limited number of techniques available for neutral atmospheric measurements. For individual titles, see N86-26726 through N86-26734.

N86-26726*# National Aeronautics and Space Administration. Wallops Flight Center, Wallops Island, Va.

ROCKET TECHNIQUES USED TO MEASURE THE NEUTRAL ATMOSPHERE

F. J. Schmidlin *In* International Council of Scientific Unions Handbook for MAP, Vol. 19 Mar. 1986 28 p (For primary document see N86-26725 17-46)

Avail: NTIS HC A10/MF A01; also available from SCOSTEP Secretariat, University of Illinois, 1406 West Green Street, Urbana, Ill. 61801 CSCL 04A

One important facet of middle atmosphere studies is the role of direct measurements provided by rocket systems. These systems range in size from the small meteorological rocketsonde capable of providing temperature and wind data to the larger sounding rocket designed to carry much larger payloads. The more common methods of rocket meteorological measurements used today are discussed, some of which were first deployed over 25 years ago. The major emphasis is given to that system which produces the most measurements (the small meteorological rocket), the types of sensors, the role and applicability of coordinated launchings such as obtained from the Meteorological Rocket Networks, and, the data quality and uses. The large sounding rockets produce similar data but, because of the cost and complexity involved in launching these bigger vehicles, fewer data are obtained. This does not, however, detract from the value of such data. The observational virtue of rocket data is its vertical height resolution which added new information on the atmospheric structure in mesoscale and, possibly, microscale dimensions. Rocket exploration of the atmosphere has changed the popular notion that the middle and upper atmosphere is a static, quiet area, to the realization that this region is highly active and dynamic. Author

N86-26727*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ROCKET TECHNIQUES FOR MEASUREMENT OF OZONE AND RELATED NEUTRAL MINOR CONSTITUENTS

A. J. Krueger *In* International Council of Scientific Unions Handbook for MAP, Vol. 19 Mar. 1986 27 p (For primary document see N86-26725 17-46)

Avail: NTIS HC A10/MF A01; also available from SCOSTEP Secretariat, University of Illinois, 1406 West Green Street, Urbana, Ill. 61801 CSCL 04A

Rockets are the only vehicles for direct measurement of the neutral composition of the stratosphere and mesosphere above balloon altitudes (35 to 40 km). Instrumentation was developed for routine measurements of ozone using either UV absorption, chemiluminescence, or airglow techniques, and for nitric oxide using chemiluminescence. Other species which were measured are nitrogen dioxide, water vapor, hydroxyl, and atomic oxygen. Ozone was measured about 400 times, nitric oxide about 10 times, and the remaining species only one or two times. Author

N86-26728*# Denver Univ., Colo. Dept. of Physics.

MEASUREMENTS OF X-RAY ENERGY DEPOSITION IN THE MIDDLE ATMOSPHERE

J. R. Barcus *In* International Council of Scientific Unions Handbook for MAP, Vol. 19 Mar. 1986 32 p (For primary document see N86-26725 17-46)

Avail: NTIS HC A10/MF A01; also available from SCOSTEP Secretariat, University of Illinois, 1406 West Green Street, Urbana, Ill. 61801 CSCL 04A

Rocket techniques as applied to measurements in the middle atmosphere of X-rays in the 5 to 100 keV range are presented. Different types of detectors and payloads are compared in regard to their capabilities and limitations. Assessment of the energy deposition by X-rays is examined by methods involving in situ measurements and/or model-dependent calculations. Recent results illustrate the role of X-rays as an important source of ionization in the middle atmosphere at all latitudes, with the greatest range of effects taking place at high magnetic latitudes. Author

N86-26729*# Bergen Univ. (Norway). Dept. of Physics.
DETECTORS FOR MEASURING ENERGETIC CHARGED PARTICLES IN ROCKETS
F. Soraas *In* International Council of Scientific Unions Handbook for MAP, Vol. 19 Mar. 1986 14 p (For primary document see N86-26725 17-46)
Avail: NTIS HC A10/MF A01; also available from SCOSTEP Secretariat, University of Illinois, 1406 West Green Street, Urbana, Ill. 61801 CSCL 04A

The physical principles of electron and ion detection are discussed. A detector model is developed and different charged particle detectors are surveyed. It is shown how the energy and pitch angle distribution of the energetic particles can be measured. Examples of rocket instruments for charge particle measurement are shown. Author

N86-26730*# Max-Planck-Inst. fuer Kernphysik, Heidelberg (West Germany).
REVIEW OF ROCKET-BORNE ION MASS SPECTROMETRY IN THE MIDDLE ATMOSPHERE
F. Arnold and A. A. Viggiano *In* International Council of Scientific Unions Handbook for MAP, Vol. 19 Mar. 1986 36 p (For primary document see N86-26725 17-46)
Avail: NTIS HC A10/MF A01; also available from SCOSTEP Secretariat, University of Illinois, 1406 West Green Street, Urbana, Ill. 61801 CSCL 04A

Experimental methods employed in middle atmosphere rocket-borne ion mass spectrometry are reviewed with an emphasis on recent developments. Interest is also focussed on milestones in instrumental developments and related progress in the exploration of the middle atmosphere ionized component. Attention is also drawn to interesting applications of in situ ion composition measurements in the middle atmosphere, particularly the detection of neutral trace gases and microaerosols using passive chemical ionization mass spectrometry. Finally, future trends in rocket-borne ion mass spectrometry are assessed. Author

N86-26731*# Norwegian Defence Research Establishment, Kjeller.
DC-PROBE MEASUREMENTS IN THE MIDDLE ATMOSPHERE
E. V. Thrane *In* International Council of Scientific Unions Handbook for MAP, Vol. 19 Mar. 1986 17 p (For primary document see N86-26725 17-46)
Avail: NTIS HC A10/MF A01; also available from SCOSTEP Secretariat, University of Illinois, 1406 West Green Street, Urbana, Ill. 61801 CSCL 04A

Rocket-borne dc probes were used extensively to study the weakly ionized plasma in the lower ionosphere and upper stratosphere. Although based upon the same basic principle, the probes were used in many different forms to measure both ion and electron densities, as well as electron temperature, and in some cases, ion composition. In recent years, probes have been used successfully to study turbulence in the middle atmosphere. The most important electrostatic probe techniques are reviewed and the accuracy and sensitivity of the different instruments are discussed and illustrated with sample measurements. The theory for the collection of ions or electrons by means of such probes in a collision-dominated regime is complex and not well developed. Some of the theoretical difficulties are pointed out briefly. Author

N86-26732*# Pennsylvania Transportation Inst., University Park. Communications and Space Science Lab.
ROCKET PROBE TECHNIQUES FOR MEASURING BULK ION PROPERTIES
J. D. Mitchell *In* International Council of Scientific Unions Handbook for MAP, Vol. 19 Mar. 1986 18 p (For primary document see N86-26725 17-46)
Avail: NTIS HC A10/MF A01; also available from SCOSTEP Secretariat, University of Illinois, 1406 West Green Street, Urbana, Ill. 61801 CSCL 04A

An overview of rocket probe techniques for measuring middle atmosphere ion properties is presented. The measured parameters include conductivity, ion mobility and number density, all of which characterize the region's electrical structure. Particular consideration is given to the Gerdien condenser because of its capability to measure all three of these ion quantities. This probe was adapted for flight operation while either attached to a rocket or, more often, descending on a parachute. The use of a parachute potentially enhances the probe's measurement capabilities and also it lessens detrimental flow effects on ion collection. From the brief presentation of measurement results, it is demonstrated that a variety of presently flown probe systems, both supersonic and subsonic, show general consistency in measuring conductivity; and, in fact, they occasionally have been combined to enhance overall investigations. Also, it is observed that electrical conductivity is the most variable of the three parameters, having a strong dependence on temperature, solar conditions, and local ionization sources. Author

N86-26733*# Illinois Univ., Urbana. Dept. of Electrical and Computer Engineering.
ELECTRON DENSITY MEASUREMENTS IN THE MIDDLE ATMOSPHERE BY RADIO PROPAGATION TECHNIQUES
L. G. Smith *In* International Council of Scientific Unions Handbook for MAP, Vol. 19 Mar. 1986 15 p (For primary document see N86-26725 17-46)
Avail: NTIS HC A10/MF A01; also available from SCOSTEP Secretariat, University of Illinois, 1406 West Green Street, Urbana, Ill. 61801 CSCL 04A

Radio propagation between a ground-based transmitter and a rocket-borne receiver provides a useful method of obtaining the electron density structure of the middle atmosphere. The basis of the experiment is contained in magnetoionic theory. The implementation of the experiment takes the form of Faraday rotation and differential absorption; the two techniques are often combined into a single system. Author

N86-26734*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEASUREMENT TECHNIQUES FOR MIDDLE ATMOSPHERE ELECTRIC FIELDS
N. C. Maynard *In* International Council of Scientific Unions Handbook for MAP, Vol. 19 Mar. 1986 15 p (For primary document see N86-26725 17-46)
Avail: NTIS HC A10/MF A01; also available from SCOSTEP Secretariat, University of Illinois, 1406 West Green Street, Urbana, Ill. 61801 CSCL 04A

Both the difficulty of access to the region and the difficulty of measurement techniques has caused the middle atmosphere to be one of the last near Earth regions to be explored electrodynamically. Recent improvements in measurement techniques spurred by the apparent discovery of large V/m electric fields have resulted in new thrusts into this previously neglected field. Both double probe techniques and field mills were adapted for middle atmosphere measurements. A brief description of each technique is given along with some of the pitfalls and difficulties associated with middle atmosphere electric field measurements. Measurement of mV/m level electric fields is now possible in the D region. The detection of V/m level fields in the lower ionosphere remains controversial; however, increasing evidence is accumulating for their existence. Author

N86-26735*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
KINEMATICS, COMPOSITION AND THERMODYNAMICS OF THE MESOPAUSE, TURBOPAUSE, REGION OF THE ATMOSPHERE (BETWEEN 80 AND 120 KM) RELATED TO THE AEROASSISTED ORBIT TRANSFER VEHICLE (AOTV) OPERATIONS
Michael Susko Apr. 1986 21 p refs
(NASA-TM-86545; NAS 1.15:86545) Avail: NTIS HC A02/MF A01 CSCL 04A

The mesopause-turbopause region (80 to 120 km) of the atmosphere which is frequently used as a boundary between the thermosphere and mesosphere for models of the atmosphere is discussed. The initialization of models is important since uncertainties may lead to significant changes in the computations of total

density at greater altitudes. In this transition region, the experimental data base for the total gas density and the constituents of smaller abundance is very limited. The turbopause height (h sub t) may vary from 90 to 120 km and no pronounced dependence of (h sub t) on season, local time, or solar activity is determined. The importance of atmospheric turbulence is discussed and its important role in the mesosphere and lower atmosphere by influencing the thermal balance of the upper atmosphere, as well as the distribution of different atmospheric constituents, is presented. The number of measurements of turbulence at these altitudes is small. Data from radio meteors, noble gas ratio analysis, and luminescent cloud analysis reveal no definite conclusion or systematic variation of the turbulence region. The heat input by gravity waves is a dominant term in the energy balance equation. Also gravity waves, either directly or through a mechanism of turbulence generation, enhance the mixing ability of the atmosphere. Internal gravity waves produce variations in the density as well as concentration of atomic oxygen. The uncertainty in the atmospheric density variation leads to control system design problems for the AOTV relative to the control authority required to deal with the unpredictable variation in density. Author

N86-26736# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

EQUATORIAL F REGION VERTICAL PLASMA DRIFTS: SEASONAL AND LONGITUDINAL ASYMMETRIES IN THE AMERICAN SECTOR

I. S. Batista, M. A. Abdu, and J. A. Bittencourt Mar. 1986 29 p refs Sponsored in part by Fundo Nacional de Desenvolvimento Cientifico e Tecnologico. Submitted for publication
(INPE-3839-PRE/909) Avail: NTIS HC A03/MF A01

Longitudinal and seasonal asymmetries in the evening ionospheric F region plasma vertical drift (V sub z) enhancements, between two longitudinally separated stations situated along the magnetic equator, are investigated under solar maximum conditions. Results obtained from the analysis of ionosonde data acquired at the Huancayo, Peru and Fortaleza, Brazil stations are used. The two stations have markedly different magnetic declination angles. The observed asymmetries are interpreted using a detailed numerical simulation of the E and F region electrodynamic coupling process that takes into account its asymmetry about the equator arising from the finite magnetic declination angle. The results of the simulation show, in agreement with observations, that the evening F region vertical drift pre-reversal peak occurrence time and its seasonal variation at a station are controlled by the magnetic declination angle at that station, which determines the seasonal variation of the sunset times (and hence the integrated Pedersen conductivity longitudinal gradient) at its magnetic conjugate E layers. The amplitude of the pre-reversal peak, on the other hand, undergoes the influence of the magnetic declination angle as well as of the thermospheric zonal wind. Author

N86-26737# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

DYNAMICS OF NON-RELATIVISTIC EQUATORIAL ELECTRONS AND PROTONS INSIDE THE PLASMASPHERE

O. Pinto, Jr., O. Mendes, Jr., and W. D. Gonzalez Mar. 1986 25 p Sponsored in part by Fundo NACIONAL DE Desenvolvimento Cientifico e Tecnologico. Submitted for publication
(INPE-3833-PRE/905) Avail: NTIS HC A02/MF A01

The dynamics of nonrelativistic equatorial electrons and protons inside the plasmasphere are studied. These particles are subjected to the combined action of the geomagnetic field and plasmaspheric electric fields, both assumed to be static, during magnetically quiet and distrubed periods. It is concluded that, during magnetically quiet periods, electrons tend to corotate with and simultaneously drift away from the Earth. On the other hand, protons show a more complex dynamical behavior, strongly depending on energy and local time, presenting open orbits similar to those of electons, except for an energy interval in which closed orbits exist within certain local time intervals. During magnetically disturbed periods, at least around L = 2, the behavior of electrons and protons remains approximately unchanged. Author

N86-26738# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

THERMOSPHERIC MODELS: A SHORT REVIEW ON THE BASIC ASSUMPTIONS

Carlos Jose Zamlutti Mar. 1986 35 p refs Submitted for publication
(INPE-3823-PRE/899) Avail: NTIS HC A03/MF A01

Thermospheric models vary in a wide range of approaches: theoretical, analytical, semiempirical, numerical, etc. The models should be used only if the basic assumption, on which they are based, are valid. This paper deals with a critical review of thermospheric models keeping in view that they are designed to predict the actual behavior of the neutral atmosphere parameters above 90 km. Emphasis is put on the lower thermosphere to avoid interhemispheric transport effect, not included in most of the models. Author

N86-26739*# Iowa Univ., Iowa City.

INVESTIGATION OF THE DIFFUSE ULTRAVIOLET BACKGROUND USING SATELLITE DATA: DYNAMICS EXPLORER GUEST INVESTIGATOR PROGRAM Final Technical Report, 15 Jul. 1984-14 Jan. 1986

John D. Fix 27 Jun. 1986 10 p refs
(Grant NAG5-449)
(NASA-CR-176809; NAS 1.26:176809) Avail: NTIS HC A02/MF A01 CSCL 04A

The imaging instrumentation for the Dynamics Explorer Mission was designed primarily to obtain global auroral images. The instrument, however, was also used successfully to study marine bioluminescence, the geocorona, and the global distribution of atmospheric ozone. The imager has considerable potential for the study of astronomical sources of ultraviolet radiation as well. The data produced by the imager is used to study the brightness and isotrophy of the diffuse ultraviolet background. Author

N86-26740*# Bechtel National, Inc., San Francisco, Calif.

THEMATIC MAPPER RESEARCH IN THE EARTH SCIENCES: TECTONIC EVALUATION OF THE NUBIAN SHIELD OF NORTHEASTERN SUDAN/SOUTHEASTERN EGYPT USING THEMATIC MAPPER IMAGERY Interim Report

Feb. 1986 24 p refs Original contains color illustrations
(Contract NAS5-28757)
(NASA-CR-177311; NAS 1.26:177311) Avail: NTIS HC A02/MF A01 CSCL 08G

The tectonic evaluation of the Nubian Shield using the Thematic Mapper (TM) imagery is progressing well and shows great promise. The TM tapes for the six LANDSAT 5 scenes covering the northern portion of the Red Sea hills were received, and preliminary maps and interpretations were made for most of the area. It is apparent that faulting and shearing associated with the major suture zones such as the Sol Hamed are clearly visible and that considerable detail can be seen. An entire quadrant of scene 173,45 was examined in detail using all seven bands, and every band combination was evaluated to best display the geology. A comparison was done with color ratio combinations and color combinations of the eigen vector bands to verify if band combinations of 7-red, 4-green, and 2-blue were indeed superior. There is no single optimum enhancement which provides the greatest detail for every image and no single combination of spectral bands for all cases, although bands 7, 4, and 2 do provide the best overall display. The color combination of the eigen vector bands proved useful in distinguishing fine detailed features. B.G.

N86-26741*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Studies.

PLATE MOTIONS AND DEFORMATIONS FROM GEOLOGIC AND GEODETIC DATA Semiannual Report, 1 Aug. 1984 - 31 Dec. 1985

Thomas H. Jordan 30 Jun. 1986 53 p
(Grant NAG5-459)
(NASA-CR-177299; NAS 1.26:177299) Avail: NTIS HC A04/MF A01 CSCL 08G

Research effort on behalf of the Crustal Dynamics Project

focused on the development of methodologies suitable for the analysis of space-geodetic data sets for the estimation of crustal motions, in conjunction with results derived from land-based geodetic data, neo-tectonic studies, and other geophysical data. These methodologies were used to provide estimates of both global plate motions and intraplate deformation in the western U.S. Results from the satellite ranging experiment for the rate of change of the baseline length between San Diego and Quincy, California indicated that relative motion between the North American and Pacific plates over the course of the observing period during 1972 to 1982 were consistent with estimates calculated from geologic data averaged over the past few million years. This result, when combined with other kinematic constraints on western U.S. deformation derived from land-based geodesy, neo-tectonic studies, and other geophysical data, places limits on the possible extension of the Basin and Range province, and implies significant deformation is occurring west of the San Andreas fault. A new methodology was developed to analyze vector-position space-geodetic data to provide estimates of relative vector motions of the observing sites. The algorithm is suitable for the reduction of large, inhomogeneous data sets, and takes into account the full position covariances, errors due to poorly resolved Earth orientation parameters and vertical positions, and reduces baises due to inhomogeneous sampling of the data. This methodology was applied to the problem of estimating the rate-scaling parameter of a global plate tectonic model using satellite laser ranging observations over a five-year interval. The results indicate that the mean rate of global plate motions for that interval are consistent with those averaged over several million years, and are not consistent with quiescent or greatly accelerated plate motions. This methodology was also used to provide constraints on deformation in the western U.S. using very long baseline interferometry observations over a two-year period. M.G.

N86-26742# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.

PARTICLE AND WAVE DYNAMICS DURING PLASMA INJECTIONS

H. C. Koons and J. F. Fennell 15 Jul. 1985 34 p refs
(Contract F04701-83-C-0084)
(AD-A163210; TR-0084A(5940-06)-3; SD-TR-85-51) Avail: NTIS HC A03/MF A01 CSCL 04/1

The SCATHA satellite measures particle and wave parameters as it moves outbound on the dusk side from the plasmasphere into the plasma sheet. In many cases plasma waves are not observed in the quiescent plasma sheet prior to a plasma injection. The electron distribution function prior to entry into the plasma sheet is a nearly isotropic soft spectrum J(E) approx. 1/E. Just inside the plasma sheet the spectrum begins to harden and becomes anisotropic, J perpendicular greater than J parallel. As the satellite penetrates deeper into the plasma sheet the spectrum further hardens, especially near alpha sub 0 approx. 90 deg. At the injection the electron spectrum drastically hardens and often becomes peaked in the keV energy range. The pitch angle anisotropy is further enhanced in favor of J perpendicular. The plasma wave emissions onset occurred at the time of the injection. Whistler-mode waves are observed below the electron cyclotron frequency. Electrostatic waves are detected in bands between the electron cyclotron frequency harmonics. GRA

N86-26743# Pacific-Sierra Research Corp., Los Angeles, Calif.

RADIATION OF LONG ELECTROMAGNETIC WAVES BY A MODULATED ELECTRON BEAM IN THE IONOSPHERE Final Report, Dec. 1983 - Aug. 1985

E. C. Field and L. E. Johnson Dec. 1985 45 p
(Contract F19628-84-C-0014)
(AD-A163306; PSR-1566; RADC-TR-85-233) Avail: NTIS HC A03/MF A01 CSCL 04/1

Pulsed electron beams in the ionosphere radiate electromagnetic energy and, therefore, might work as wireless virtual antennas. Such virtual antennas would be most useful at low frequencies because small or moderate-size wire antennas work well at high frequencies. Natural beams radiate energy that propagates down through the ionosphere, but no experiment has used a man-made electron beam to produce radiation at the modulation frequency or its harmonics, and detected that radiation on the ground. The present report addresses the feasibility of such an experiment, and suggests preferred configurations. Motivated by communications applications, which require good time availability, it considers only phenomena, such as the triggering plasma of instabilities or guidance in transient ionospheric ducts. GRA

N86-26744# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.

WAVES AND ELECTRIC FIELDS ASSOCIATED WITH THE DECEMBER 27, 1984, ARTIFICIAL COMET Progress Report

D. A. Gurnett, T. Z. Ma, R. R. Anderson, G. Haerendel, and G. Paschmann 27 Nov. 1985 71 p
(Contracts N00014-82-K-0183; N00014-85-K-0404)
(AD-A163409; U-Of-Iowa-85-18) Avail: NTIS HC A04/MF A01 CSCL 04/1

A variety of plasma wave and electric field effects were observed during the AMPTE (Active Magnetospheric Particle Tracer Explorers) solar wind barium release. Electron plasma oscillations at the local electron plasma frequency provided measurements of the electron density during the entire event. A static electric field of about 1 to 2 mVolt/m was detected in the diamagnetic cavity. This electric field is in the same direction as the solar wind electric field, suggesting that polarization charges in the ion cloud are not effective at shielding out an external electric field. As the spacecraft passed through the boundary of the diamagnetic cavity, a region of compressed plasma and magnetic field was detected upstream of the ion cloud. This region of compressed plasma is believed to be caused by solar wind plasma and magnetic field lines draped around the noise of the ion cloud. Inside the diamagnetic cavity electrostatic emissions were observed in a narrow band centered on the barium ion plasma frequency and in another band at lower frequencies. These waves are believed to be short wavelength ion acoustic waves. Bursts of electrostatic waves were also observed at the boundaries of the diamagnetic cavity, apparently caused by an electron drift current along the boundary. GRA

N86-26745# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.

THE STUDY OF GRAVITY FIELD ESTIMATION PROCEDURES Final Report, 22 Dec. 1981 - 30 Jun. 1985

Richard H. Rapp Sep. 1985 12 p refs
(Contract F19628-82-K-0022)
(AD-A164564; AFGL-TR-85-0278) Avail: NTIS HC A02/MF A01 CSCL 08/5

The research described includes the use of high degree potential coefficient expansions, vertical datum corrections, improved gravity fields from satellite altimetry, the computation of the gravity vector in space and the use of digital terrain models for gravimetric computations. GRA

N86-26746# Saint Louis Univ., Mo.

ATTENUATION OF SEISMIC WAVES AT REGIONAL DISTANCES Scientific Report, 1 Jan. - 30 Jun. 1985

Otto W. Nuttli, Brian J. Mitchell, and H. J. Hwang 15 Aug. 1985 104 p refs
(Contract F19628-85-K-0021; ARPA Order 5299)
(AD-A164617; AFGL-TR-85-0185; SR-1) Avail: NTIS HC A06/MF A01 CSCL 17/10

A report on the attenuation of seismic waves at regional distances contains the following topics: Yield estimates of Nevada Test Site explosions obtained from siesmic Lg waves; Inter-station surface wave analysis by frequency-domain Wiener deconvolution and modal isolation; New insights on crustal Q structure in stable continental regions - preliminary results. GRA

N86-26747# Atmospheric and Environmental Research, Inc., Cambridge, Mass.

THE NEUTRAL/ION CHEMISTRY OF SODIUM IN THE STRATOSPHERE AND MESOSPHERE

Jose M. Rodriguez, Malcolm K. W. Ko, and Nien D. Sze 30 Sep. 1985 59 p
(Contract F19628-83-C-0123)
(AD-A164636; AFGL-TR-85-0237; SR-2) Avail: NTIS HC A04/MF A01 CSCL 04/1

Part A of the report presents results from our model calculation of the diurnal behavior of the neutral and ionic sodium species. It is shown that the concentration of Na(+) above 90 km exerts a direct influence on the topside scale height of the atomic sodium layer in the mesosphere. The abundance of Na(+) is controlled by the reaction rate for the clustering reaction which is the rate limiting step for the conversion of Na(+) to Na. Downward transport of Na(+) due to ion drift is also effective in reducing the sodium abundance around 90 km. The model can successfully simulate the observed topside scale height of the sodium layer by either using a slow rate for the clustering reaction or incorporating transport of Na(+). Part B assesses the possible impact of sodium species on the stratospheric chlorine cycle. Recent measurements of kinetic rates suggest that the bulk of the sodium species could be in the form of NaCl in the stratosphere. Since the sodium abundance is three orders of magnitude smaller than that of chlorine, NaCl is not likely to be an important chlorine reservoir. Photolysis of NaCl could provide a mechanism for recycling HCl to Cl in the lower stratosphere if it is as fast as 0.001/s. However, the mechanism would not be effective if there exists another more stable form of sodium compound, such as NaHC03 or polymers of NaCl. GRA

N86-26748# Schmitt (Rainer), Glashutten (West Germany).
INVESTIGATIONS OF THE MICRO-TURBULENCE IN THE BOTTOM OF THE BOUNDARY LAYER Final Report
Rainer Schmitt 31 Dec. 1985 92 p
(Contracts DAJA45-83-C-0038; DA Proj. 1T1-61102-BH-57)
(AD-A165306; AD-E301922) Avail: NTIS HC A05/MF A01 CSCL 04/1

Measurements of the microturbulence in the bottom of the atmospheric boundary layer using a two-ended scintillometer system have been performed at two sites in West Germany: more than 500 hours in a hilly area, 180 hours near the coast of the North Sea. The data are presented as figures: signal as function of time. The signal monitored corresponds to the refractive index structure parameter (Cn2) averaged over the path between an incoherent light source and a signal receiver. The reported values are proportional to the logarithm of Cn2. GRA

N86-26749# Analytic Sciences Corp., Reading, Mass.
GRAVITY GRADIOMETER SURVEY ERRORS Report, Nov. 1984 - Apr. 1985
Steven J. Brzezowski Mar. 1985 37 p
(Contract F19628-83-C-0053)
(AD-A165575; TASC-TR-4423-3; AFGL-TR-85-0066; SR-4) Avail: NTIS HC A03/MF A01 CSCL 08/5

Gradiometer system noise, sampling effects, downward continuation and limited data extent contribute to moving-base gravity gradiometer survey error. This report describes the individual effects of these error sources on a gravity gradiometer survey system currently under development. Special techniques are required to account for downward continuation and limited data extent effects which cannot be adequately modeled as measurement noise in a linear error estimation algorithm. The results reported herein indicate the survey performance improvement which could be realized if each error source were totally eliminated. The sensitivity of total survey error to small changes in the nominal value of each error source is also identified. System performance results are analyzed for several sets of airborne survey conditions. For a typical characterization of the Earth's gravity field, limited data extent generally contributes about one-half of the total error variance associated with recovery of the gravity disturbance vector at the Earth's surface; gradiometer system noise typically contributes about one-third. However, sampling effects are also very significant (and are controlled through the survey track spacing). The findings of this study indicate that a 5-km track spacing provides a reasonable tradeoff between survey cost and errors due to track spacing. Author (GRA)

N86-26750# Freiburg Univ. (West Germany). Inst. of Sound and Vibration Research.
STUDY OF IONOSPHERIC AND TROPOSPHERIC MODELS Final Report
Karl Rawer, comp. and Dieter Bilitza, comp. Paris ESA Sep. 1985 93 p
(Contract ESA-5375/83-D)
(ESA-CR(P)-2157; ESA-86-96859) Avail: NTIS HC A05/MF A01

To improve Bent's ionospheric model, the source of the NASA model applied by ESOC when computing the ionospheric refraction correction at radio location of satellites, empirical data were compared with the model and with proposed changes. The most important improvements proposed refer to the shape of the electron density profile and to the ionospheric peak parameters. A saturated relation instead of a linear one is proposed for the solar activity effect, and a provisional formula for taking account of the plasmaspheric content is given. Observations made by ESOC ground stations were used to check the models. It is found that the proposed changes are helpful and provide an overall improvement. ESA

N86-26751# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Applied Mathematics.
EFFECT OF STOCHASTIC PERTURBATIONS ON A SPECTRAL MODEL OF ATMOSPHERIC CIRCULATION
H. E. deSwart and J. Grasman Nov. 1985 21 p Revised Sponsored by Netherlands Foundation for the Technical Sciences (CWI-AM-R8515; B8578049; ESA-86-97001) Avail: NTIS HC A02/MF A01

The dynamics of a low order spectral model of the barotropic potential vorticity equation, forced by random perturbations, is studied as a function of the memory and intensity of the noise. The unperturbed deterministic system has three equilibria, and for arbitrary initial conditions trajectories in phase space always tend to one of the two stable equilibria representing preferent circulation patterns of the atmosphere. The noise forces the system to visit alternately the two attraction domains of the stable equilibria. During the transition the system remains temporarily in a neighborhood of the unstable equilibrium. Characteristic residence times in the attraction domains and in the domain near the unstable equilibrium are calculated. The alternation of preferent states is studied with a discrete state Markov model. The eigenvalues of the Markov model indicate the time scale over which the effect of the initial state is present in the system. ESA

N86-26752# South Carolina Univ., Columbia. Dept. of Civil Engineering.
INVESTIGATION OF SUBSURFACE EXPLORATION METHODS FOR PREVAILING GEOLOGIC CONDITIONS IN SOUTH CAROLINA Final Report
R. L. Baus Nov. 1985 161 p Sponsored in cooperation with the Federal Highway Administration and South Carolina Dept. of Highways and Public Transportation
(PB86-167087; RR-F85-203; FHWA/SC-85/01) Avail: NTIS HC A08/MF A01 CSCL 08G

Subsurface conditions at sites in the coastal plains region of South Carolina were investigated using standard penetration and mechanical quasi-static cone penetration tests. The penetration test results are compared with measured static axial pile capacity. The cone penetration test results are compared with stratigraphy and soil types encountered at each site. Results show that with certain limitations, cone penetration test results can be used to assess general stratigraphy and soil type and predict static axial pile capacity with reasonable accuracy. GRA

N86-26753# National Geodetic Survey, Rockville, Md.
MODEL COMPARISON IN VERTICAL CRUSTAL MOTION ESTIMATION USING LEVELING DATA
G. W. Hein Feb. 1986 49 p
(PB86-175551; NOAA-TR-NOS-117; NGS-35) Avail: NTIS

HC A03/MF A01 CSCL 08E

A new generalized linear regression model, also called mixed model, is presented for the computation of zero-epoch heights and height velocities using releveling observations. The method is compared with the single point velocity model having a multiquadric interpolator for the velocity surface. Tests based on simulated error free and noisy data show slight advantages for the mixed model. The multiquadric technique provides a good interpolation method in the deterministic sense when certain specific precautions are considered. Error statistics of multiquadrics using a stochastic approach through least squares should be interpreted with extreme care. GRA

N86-26754# National Geodetic Survey, Rockville, Md.
MEGATREND SOLUTIONS IN PHYSICAL GEODESY
A. Bjerhammar Feb. 1986 35 p
(PB86-173317; NOAA-TR-NOS-116; NGS-34) Avail: NTIS HC A03/MF A01 CSCL 08E

A technique for renormalization of integral equations is used for obtaining very robust solutions. The number of multiplications used for inverting the integral equations can be reduced dramatically and mostly only weighted means will be needed. Theoretical proportional gain in computer time might be as much as 100,000 for the most favorable cases when using 1,000 unknowns. (Practical gains will be considerably less.) Solutions were obtained with increased accuracy compared with the classical technique of integral equations. Surface elements could be of arbitrary size, but the method is optimal for a global approach with equal area elements. The solutions were found strictly invariant with respect to the depth of the embedded sphere when using simpler models. GRA

N86-26755# National Geodetic Survey, Rockville, Md.
BLUE RIDGE GRAVIMETER CALIBRATION BASE LINE, ESTABLISHED 1985
C. W. Wessells Dec. 1985 58 p
(PB86-167475; NOAA-TM-NOS-NGS-44) Avail: NTIS HC A04/MF A01 CSCL 08E

As with almost all scientific instrumentation, some method of calibration is necessary to achieve optimum results in a given investigation. The same holds true for gravimeters. The Blue Ridge Gravimeter Calibration Base Line provides the user with an overall 310-mgal gravity range (10-mgal intervals) for calibration of gravimeters reading to plus or minus 0.01 mgal and a 10-mgal range (1mgal interval) for the more sensitive gravimeters, reading to plus or minus 0.001 mgal. This line will enable the user to determine scale constants for each interval as well as circular error contributions for their gravimeters. GRA

N86-26851*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE PRODUCTION OF TRACE GASES BY PHOTOCHEMISTRY AND LIGHTNING IN THE EARLY ATMOSPHERE
Joel S. Levine, Geoffrey M. Tennille, Kenneth M. Towe (Smithsonian Institution, Washington, D. C.), and Raj K. Khanna (Maryland Univ., College Park.) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 47 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

N86-27157*# Guelph Univ. (Ontario).
THE INITIATION OF GRAIN MOVEMENT BY WIND
W. G. Nickling *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N86-26756*# Atmospheric and Environmental Research, Inc., Cambridge, Mass.

GENERATION OF AVAILABLE POTENTIAL ENERGY AND THE ENERGY CYCLE DURING THE GLOBAL WEATHER EXPERIMENT Final Report
David A. Salstein and Richard D. Rosen Apr. 1986 30 p refs (Contract NAS5-27745)
(NASA-CR-177872; NAS 1.26:177872) Avail: NTIS HC A03/MF A01 CSCL 04B

Two major themes were pursued during this research period. The first of these involved examining the impacts of satellite-based data and the forecast model used by the Goddard Laboratory for Atmospheres (GLA) on general circulation statistics. For the other major topic, the diabatic heating fields produced by GLA were examined for one month during the FGGE First Special Observing Period. As part of that effort, the three-dimensional distribution of the four component heating fields were studied, namely those due to shortwave radiation, Q sub SW, longwave radiation, Q sub LW, sensible heating, Q sub S, and latent heating, Q sub L. These components were calculated as part of the GLA analysis/forecast system and archived every quarter day; from these archives cross products with temperature were computed to enable the direct calculation of certain terms of the large-scale atmospheric energy cycle, namely those involving the generation of available potential energy (APE). The decision to archive the diabatic heating components separately has enabled researchers to study the role of the various processes that drive the energy cycle of the atmosphere. Author

N86-26757# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
COMPARISON OF RAINFALL CHARACTERISTICS AT FORTALEZA (CEARA) AND OTHER NEARBY LOCATIONS IN NORTHEAST BRAZIL
R. P. Kane and N. B. Trivedi Apr. 1986 63 p refs Sponsored in part by Fundo Nacional de Desenvolvimento Cientifico e Tecnologico. Submitted for publication
(INPE-3851-PRE/915) Avail: NTIS HC A04/MF A01

The rainfall series of Fortaleza (Ceara) is compared with similar series for several other locations in Northeast Brazil. It is shown that the correlations are good for distances up to about 600 km from Fortaleza. A Master Curve for 1912-1978, obtained by averaging rainfall data for 93 stations having good correlations with Fortaleza, shows very prominent periodicities at T = 5.6, 12.3, and 47.3 years and less prominent periodicities at T = 3.4 and 4.3 years. Predictions from both the Fortaleza series (1849-1976) and the Master Curve (1912-1978) indicated droughts during 1979-1983. This prediction seems to have been realized. In future, droughts during 1992-1994 and 2002-2006 are indicated. Author

N86-26758*# Florida State Univ., Tallahassee. Dept. of Meteorology.
AN INVESTIGATION OF THE MARINE BOUNDARY LAYER DURING COLD AIR OUTBREAK Final Report
Steven A. Stage Jul. 1986 26 p refs
(Grant NAG5-332)
(NASA-CR-177287; NAS 1.26:177287) Avail: NTIS HC A03/MF A01 CSCL 04B

Methods for use in the remote estimation of ocean surface sensible and latent heat fluxes were developed and evaluated. Three different techniques were developed for determining these fluxes. These methods are: (1) Obtaining surface sensible and latent heat fluxes from satellite measurements; (2)Obtaining surface sensible and latent heat fluxes from an MABL model; (3) A method using horizontal transfer coefficients. These techniques are not very sensitive to errors in the data and therefore appear to hold promise of producing useful answers. Questions remain about how closely the structure of the real atmosphere agrees with the assumptions made for each of these techniques, and, therefore about how well these techniques can perform in actual use. The value of these techniques is that they promise to provide methods

for the determination of fluxes over regions where very few traditional measurement exist. E.R.

N86-26759# Naval Research Lab., Washington, D. C.
RELATIVE - HUMIDITY PARAMETERIZATION OF THE NAVY AEROSOL MODEL (NAM) Interim Report
Hermann E. Gerber 30 Dec. 1985 16 p
(AD-A163209; NRL-8956) Avail: NTIS HC A02/MF A01 CSCL 04/2

An improved relative-humidity parameterization is described for the lognormal size distributions used in the Navy aerosol model. Approximation formulas are developed for the geometric mean and standard deviation of the distributions for sea-salt, urban, and rural aerosols. The parameterization gives accurate predictions of the size dependence of the aerosol particles for a range in relative humidity from near 0% to 100%, and for dry particle sizes from 0.01 to 10 microns. By neglecting the Kelvin effect, the new formulas reduce to a form similar to the existing humidity parameterization. The range of applicability of the new formula and its reduced form for estimating extinction coefficients are established. GRA

N86-26760# National Center for Atmospheric Research, Boulder, Colo.
A STUDY OF THE METHODOLOGY OF LOW-ALTITUDE WIND SHEAR DETECTION WITH SPECIAL EMPHASIS ON THE LOW LEVEL WIND SHEAR ALERT SYSTEM CONCEPT Final Report, Oct. 1983 - Jul. 1985
F. W. Wilson, Jr. and John A. Flueck Feb. 1986 112 p
(Contract DTFA01-82-Y-10513)
(AD-A164939; JAWS-NCAR-02-85; FAA-RD-PM-86-4) Avail: NTIS HC A06/MF A01 CSCL 04/2

This basic principles study of the Low Level Wind Shear Alert System (LLWAS) addresses the question of the degree to which a change of algorithm and network geometry can improve the performance of an anemometer-based wind shear detection system to an acceptable level. The performance of the current system seems to be deficient in that it is ineffective for the detection of microburst and that it issues many alarms in situations where pilots do not experience hazardous wind shear. The theoretical basis for this investigation is simulation testing. This process involves testing each combination of algorithm and geometry against a realistic mathematicly generated weather model that includes wind shear events. The binary time series of (event/no event) and (detection/no detection) are computed and the systems that exhibit the best skill are determined. The systems that have the best skills have high probabilities of detection and low probabilities of false alarms. GRA

N86-26761# Weather Squadron (2nd), Patrick AFB, Fla. Detachment 11.
UPGRADE OF WEATHER FORECAST SUPPORT TO SHUTTLE OPERATIONS Final Status Report
Thomas M. Myers and Billie F. Boyd 11 Apr. 1985 9 p refs
(AD-A164967; Rept-2WS/CP-85/002) Avail: NTIS HC A02/MF A01 CSCL 04/2

The report details the background of a joint USAF and NASA project to upgrade the forecast inputs at the Cape Canaveral Forecast Facility (CCFF) in support of Space Shuttle and missile launch operations at the Eastern Test Range (ETR). Prior to the start of Shuttle Operations, the CCFF had been geared to support missile launches with forecast requirements slanted towards launch pad safety (lightning, high winds, toxic diffusion) and upper air wind shears. Shuttle support added the problems of forecasting safe conditions (visibility, ceilings, crosswinds, precipitation and turbulence) for Shuttle emergency landing immediately following a launch attempt or for normal end of mission landing at the Kennedy Space Center Shuttle Landing Facility. The short range and microscale forecast requirements for Shuttle could not be met with the inplace technology. To deal with this support capability shortfall, NASA and the USAF (Det 11, 2WS and the Eastern Space and Missile Center) initiated a Meteorological Systems Modernization Program (MSMP) The intent of this weather support upgrade is to minimize the impacts of the environment on the Shuttle by providing the most accurate possible forecast advice to support managers during processing, launch, and recovery operations. Shuttle weather sensitivities are presented along with the architecture of the forecast support system being assembled to meet these challenges. Author (GRA)

N86-26762# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
WEATHER RADAR STUDIES Quarterly Technical Summary Report, 1 Apr. - 30 Jun. 1985
James E. Evans 30 Jun. 1985 65 p
(Contracts DTFA01-80-Y-10546; F19628-85-C-0002)
(AD-A165221; DOT/FAA/PM-85-28) Avail: NTIS HC A04/MF A01 CSCL 04/2

FFA-funded Doppler weather radar activities during the period 1 April to 30 June 1985 are reported. The test-bed Doppler weather radar system making measurements in Olive Branch, Mississippi, was fully operational. Additionally, the University of North Dakota C-band Doppler weather radar commenced measurements. Weather measurements were conducted on a number of cold front passages with attendent prefrontal lines of showers and thunderstorms and on scattered air mass thunderstorms. Some 17 microbursts were observed during the radar operation with the bulk of the microburst occurring in late June. Thirty-one gust fronts were observed as well. The University of North Dakota Citation aircraft made airborne turbulence measurements on eight days in the period mid-May to mid-June. The Lincoln mesonet was fully operational throughout the period. The 1984 peak wind speed data from the mesonet and the Memphis International Airport LLWSAS data have been analyzed to determine ground level wind-shear characteristics in the Memphis area. Doppler weather radar data from the National Center for Atmospheric Research JAWS program and the National Severe Storms Laboratory are being analyzed to develop low-altitude wind-shear detection algorithms. Analysis continued of the data collected in the 1983 Boston area coordinated aircraft-Doppler weather radar turbulence experiment. Work continued on the development of weather radar products for the Central Weather Processor. Author (GRA)

N86-26763# Miami Univ., Fla. School of Marine and Atmospheric Science.
GENESIS OF MAJOR DUST STORMS IN WEST AFRICA DURING THE SUMMER OF 1974
M. Estoque, J. Fernandez-Partagas, D. M. Helgren, and J. M. Prospero Jan. 1986 60 p
(Contract DAAG29-83-K-0082)
(AD-A165457; ARO-19684.2-GS) Avail: NTIS HC A04/MF A01 CSCL 04/2

The occurrence of major dust clouds over the western Sahara is associated with several characteristic features of the large scale synoptic conditions, including the isallobaric pattern as well as the flow patterns at the 850 to 700 mb layer and the surface. A necessary ingredient for the occurrence of dust appears to be the existence of a well developed and intense surface cyclone along the ITF south of the dust source region. These three features are incorporated in three synoptic models for dust generation. The models are: the general model (GM), the model without a trough (NTM) and the model with a trough (TM). Conditions resembling those in the TM appear to be the ones most frequently observed during dust episodes in GATE. Author (GRA)

N86-26764# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS (RUSSWO). PARTS A-F, KUNSAN AB, SOUTH KOREA Data Summary Report, Sep. 1974 - Aug. 1984
30 Sep. 1985 296 p
(AD-A165553; USAFETAC/DS-85/055) Avail: NTIS HC A13/MF A01 CSCL 04/2

A six-part statistical data summary of surface weather observations for: Kusan AB, Korea. Summary consists of: PART A, Weather Conditions and Atmospheric Phenomena; PART B, Precipitation; PART C, Surface Winds; PART D, Ceiling and Visibility; PART E,

Psychrometric Summaries; PART F, Pressure Summaries. See USAFETAC/TN-83/001 (AD-A132186), An Aid for Using the Revised Uniform Summary of Surface Weather Observations (RUSSWOs) for complete descriptions of contents and instructions for use. GRA

N86-26765# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS (RUSSWO). PARTS A-F, INDIAN MOUNTAIN AFS, ALASKA Data Summary Report, Dec. 1976 - Nov. 1984
1 Nov. 1985 295 p
(AD-A165554; USAFETAC/DS-85/056) Avail: NTIS HC A13/MF A01 CSCL 04/2

A six-part statistical data summary of surface weather observations for: Indian Mountain AFS, Alaska. Summary consists of: PART A, Weather Conditions and Atmospheric Phenomena; PART B, Precipitation; PART C, Surface Winds; PART D, Ceiling and Visibility; PART E, Psychrometric Summaries; PART F, Pressure Summaries. See USAFETAC/TN-83/001 (AD-A132186), An Aid for Using the Revised Uniform Summary of Surface Weather Observations (RUSSWOs) for complete descriptions of contents and instructions for use. GRA

N86-26766# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS (RUSSWO). PARTS A-F, KELLY AFB, TEXAS Data Summary Report, Sep. 1975 - Aug. 1985
6 Nov. 1985 303 p
(AD-A165555; USAFETAC/DS-85/057) Avail: NTIS HC A14/MF A01 CSCL 04/2

A six-part statistical data summary of surface weather observations for: Kelly AFB, Texas. Summary consists of: PART A, Weather Conditions and Atmospheric Phenomena; PART B, Precipitation; PART C, Surface Winds; PART D, Ceiling and Visibility; PART E, Psychrometric Summaries; PART F, Pressure Summaries. See USAFETAC/TN-83/001 (AD-A132186), An Aid for Using the Revised Uniform Summary of Surface Weather Observations (RUSSWOs) for complete descriptions of contents and instructions for use. GRA

N86-26767# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS (RUSSWO). PARTS A-F, TIN CITY AFS, ALASKA Data Summary Report, Dec. 1974 - Nov. 1984
27 Dec. 1985 296 p
(AD-A165556; USAFETAC/DS-86/002) Avail: NTIS HC A13/MF A01 CSCL 04/2

A six-part statistical data summary of surface weather observations for: Tin City AFS, Alaska. Summary consists of: PART A, Weather Conditions and Atmospheric Phenomena; PART B, Precipitation; PART C, Surface Winds; PART D, Ceiling and Visibility; PART E, Psychrometric Summaries; PART F, Pressure Summaries. See USAFETAC/TN-83/001 (AD-A132186), An Aid for Using the Revised Uniform Summary of Surface Weather Observations (RUSSWOs) for complete descriptions of contents and instructions for use. GRA

N86-26768# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS (RUSSWO). PARTS A-F, CAPE LISBURNE, ALASKA Data Summary Report, Dec. 1974 - Nov. 1984
9 Jan. 1986 296 p
(AD-A165557; USAFETAC/DS-86/003) Avail: NTIS HC A13/MF A01 CSCL 04/2

A six-part statistical data summary of surface weather observations for: Cape Lisburne, Alaska. Summary consists of: PART A, Weather Conditions and Atmospheric Phenomena; PART B, Precipitation; PART C, Surface Winds; PART D, Ceiling and Visibility; PART E, Psychrometric Summaries; PART F, Pressure Summaries. See USAFETAC/TN-83/001 (AD-A132186), An Aid for Using the Revised Uniform Summary of Surface Weather Observations (RUSSWOs) for complete descriptions of contents and instructions for use. GRA

N86-26769# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS (RUSSWO). PARTS A-F, LANGLEY AFB, VIRGINIA Data Summary Report, Sep. 1975 - Aug. 1985
13 Jan. 1986 300 p
(AD-A165558; USAFETAC/DS-86/004) Avail: NTIS HC A13/MF A01 CSCL 04/2

A six part statistical data summary of surface weather observations for Langley AFB, Virginia is presented. The summary consists of: PART A, Weather conditions and atmospheric phenomena; PART B, Precipitation; PART C, Surface winds; PART D, Ceiling and visibility; PART E, Psychrometric summaries. See USAFETAC/TN-83/001 (AD-A132186), An Aid for Using the Revised Uniform Summary Of Surface Weather Observations (RUSSWOs) for complete description of contents and instructions for use. GRA

N86-26770# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS (RUSSWO). PARTS A-F, TATALINA AFS, ALASKA Data Summary Report, Dec. 1976 - Nov. 1984
16 Jan. 1986 294 p
(AD-A165559; USAFETAC/DS-86/005) Avail: NTIS HC A13/MF A01 CSCL 04/2

A six-part statistical data summary of surface weather observations for: Tatalina AFS, Alaska. Summary consists of: PART A, Weather Conditions and Atmospheric Phenomena; PART B, Precipitation; PART C, Surface Winds; PART D, Ceiling and Visibility; PART E, Psychrometric Summaries; PART F, Pressure Summaries. See USAFETAC/TN-83/001 (AD-A132186), An Aid for Using the Revised Uniform Summary of Surface Weather Observations (RUSSWOs) for complete descriptions of contents and instructions for use. GRA

N86-26771# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS (RUSSWO). PARTS A-F, BEALE AFB, CALIFORNIA Data Summary Report, Dec. 1975 - Nov. 1985
6 Feb. 1986 437 p
(AD-A165560; USAFETAC/DS-86/006) Avail: NTIS HC A19/MF A01 CSCL 04/2

A six-part statistical data summary of surface weather observations for: Beale AFB, California. Summary consists of: Part A, Weather Conditions and Atmospheric Phenomena; Part B, Precipitation; Part C, Surface Winds; Part D, Ceiling an Visibility; Part E, Psychrometric Summaries; Part F, Pressure summaries. See USAFETAC/TN-83/001 (AD-A132186), and An Aid for Using the Revised Uniform Summary of Surface Weather Observations (RUSSWOs) for completed descriptions of contents and instructions for use. GRA

N86-26772# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS (RUSSWO). PARTS A-F, LA CROSSE MUNICIPAL AIRPORT, WISCONSIN Data Summary Report, Sep. 1975 - Aug. 1985
3 Feb. 1986 296 p
(AD-A165561; USAFETAC/DS-86/008) Avail: NTIS HC A13/MF A01 CSCL 04/2

A six-part statistical data summary of surface weather observations for: La Crosse Municipal Airport, WI. Summary consists of: Part A, Weather Conditions and Atmospheric Phenomena; Part B, Precipitation; Part C, Surface winds; Part D, Ceiling and Visibility; Part E, Psychrometric Summaries; Part F, Pressure Summaries. See USAFETAC/TN-83/001 (AD-A132186), An Aid for Using the

Revised Uniform Summary of Surface Weather Observations (RUSSWOs) for complete descriptions of contents and instructions for use. GRA

N86-26773# Air Force Environmental Technical Applications Center, Scott AFB, Ill.

CAMP CASEY, SOUTH KOREA LIMITED SURFACE OBSERVATIONS CLIMATIC SUMMARY (LISOCS). PARTS A, C-F Data Summary Report, Sep. 1975 - Aug. 1985

24 Dec. 1985 227 p

(AD-A165562; USAFETAC/DS-85/062) Avail: NTIS HC A11/MF A01 CSCL 04/2

A statistical data summary of surface weather observation climatology for: Camp Casey, South Korea. This summary is similar to the Revised Uniform Summary of Surface Weather Observations (RUSSWO), but is based on data collected from limited-duty weather observing stations; i.e., those that take weather observations less than 24 hours a day, 7 days a week. The summary is in five parts: PART A, Weather conditions and Atmospheric Phenomena; PART C, Surface Winds; PART D, Ceiling and Visibility; PART E, Psychrometric Summaries; and Part F, Pressure Summaries. Note that PART B, Precipitation, is omitted. See USAFETAC/TN-83/001 9AD-A132186), An Aide for Using the Revised Uniform Summary of Surface Weather Observations (RUSSWOs), for complete descriptions of contents of and instructions for use. GRA

N86-26774# Air Force Environmental Technical Applications Center, Scott AFB, Ill.

WESTOVER AFB, MASSACHUSETTS LIMITED SURFACE OBSERVATIONS CLIMATIC SUMMARY (LISOCS). PARTS A, C-F Data Summary Report, Oct. 1975 - Sep. 1985

6 Feb. 1986 372 p

(AD-A165563; USAFETAC/DS-86/007) Avail: NTIS HC A16/MF A01 CSCL 04/2

A statistical data summary of surface weather observation climatology for: Westover AFB, Massachusetts. This summary is similar to the Revised Uniform Summary of Surface Weather Observations (RUSSWO), but is based on data collected from limited-duty weather observing stations; i.e., those that take weather observations less than 24 hours a day, 7 days a week. The summary is in five parts: PART A, Weather Conditions and Atmospheric Phenomena; PART C, Surface Winds; PART D, Ceiling and Visibility; PART E, Psychrometric Summaries; and PART F, Pressure Summaries. Note that PART B, Precipitation, is omitted. See USAFETAC/TN-83/001 (AD-A132186), An Aid for Using the Revised Uniform Summary of Surface Weather Observations (RUSSWOs), for complete descriptions of contents and instructions for use. GRA

N86-26775# Air Force Geophysics Lab., Hanscom AFB, Mass.

TECHNIQUES FOR THE AUTOMATED OBSERVATION OF CLOUDS Final Scientific Report

James I. Metcalf 10 Oct. 1985 23 p refs

(AD-A165573; AFGL-TR-85-0253; AFGL-ERP-932) Avail: NTIS HC A02/MF A01 CSCL 04/2

This report surveys techniques for cloud detection to assess their suitability for meeting the requirements of the Automated Observation System (AOS). A microwave sensor is essential because of the requirements for observing cloud top heights and documenting multiple cloud layers. Wavelengths between 3 cm and 8.6 mm could be used for this application, and a detailed sensor design study is recommended to evaluate the availability, cost, performance, and reliability of components and systems. Pulsed or continuous-wave radars could meet most of the requirements, although measurements of cloud base with high accuracy at low altitude may be difficult with some pulsed systems. GRA

N86-26776# Brown Univ., Providence, R. I. Dept. of Geological Sciences.

MODEL VALIDATION RESEARCH: COMPARISON OF SIMULATED AND OBSERVED CLIMATE PATTERNS FOR THE PAST 18,000 YEARS Progress Report, 1 Feb. 1985 - 31 Jan. 1986

T. Webb, III Dec. 1985 26 p

(Contract DE-FG02-85ER-60304)

(DE86-004631; DOE/ER-60304/1) Avail: NTIS HC A03/MF A01

Research during 1985 was organized within four major tasks with a primary objective of testing the ability of the National Center for Atmospheric Research (NCAR) Community Climate Model (CCM) to simulate past climates. Because changes in the global mean temperature during the past 18,000 years have been similar in magnitude to those predicted for carbon dixoide doubling, the comparison of the model results with paleoclimatic data provides a useful test of the NCAR CCM, which is being used in carbon dioxide research. In particular, the data/model comparisons reveal certain of the model responses to past variations in the seasonal radiation budget. Key results included: (1) a description of a series of experiments with NCAR CCM to simulate climate for 18,000 y B.P. to present, (2) descriptions of available sea-surface temperature data from the tropics and of a global paleoclimatic data base for 6000 y B.P., (3) development of polynomial regression equations to estimate pollen percentages for temperature and precipitation data, and (4) favorable comparisons between paleoclimatic data and model results for the period 18,000 y B.P. in North America and for 18,000 B.P. to present in the Northern Hemisphere tropics. DOE

N86-26777# National Center for Atmospheric Research, Boulder, Colo.

VERTICAL MODES AND ENERGETICS OF GRAVITATIONAL AND ROTATIONAL MODES IN A MULTILEVEL GLOBAL SPECTRAL MODEL Ph.D. Thesis

S. D. Ko 1985 247 p refs Prepared in cooperation with Michigan Univ., Ann Arbor

(Grant NSF ATM-82-17015)

(PB86-160165; NCAR/CT-95) Avail: NTIS HC A11/MF A01 CSCL 04B

An energetics analysis is made based on the NCAR Community Climate Model. One difficulty, which is studied hear for the first time, is that the discrete vertical structure equation is not unique. For some typical vertical profiles of temperature and pressure, the solutions of the differential and integral vertical equations are compared. The difference between these solutions is smaller for lower baroclinic modes but larger for higher modes. The distributions of available potential energy and divergent and nondivergent kinetic energy are investigated both globally and in the tropics. New concepts of the balanced energy (BE), transient energy (TE), and balanced gravitational energy (BGE) are introduced. It is more appropriate to express the energy in terms of vertical modes rather than zonal waves in order to examine whether the energy is balanced or not during the initialization. GRA

N86-26778# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.

CLOUD BASE HEIGHTS FROM LIDAR, ROTATING BEAM CELLOMETER AND PILOT REPORTS COMPARED BY EXPERIMENT AND THEORY

W. L. Eberhard Jan. 1986 58 p refs

(PB86-159894; NOAA-TM-ERL-WPL-129) Avail: NTIS HC A04/MF A01 CSCL 04B

An experiment is described, wherein cloud signals from a range-corrected ruby lidar and a rotating beam ceilometer showed excellent agreement in the height at which peak signal occurred. To develop an understanding of the relationships between ceilometer signals and pilot visibility, the physical bases of these signals and of pilot's perceptions are analyzed. A relationship is derived that connects pilot optical depth with an idealized lidar's signal profile by applying reasonable approximations to the cloud structure (with or without precipitation). The view angle of the pilot, the lidar's pointing direction, and the vertical distribution of the obscuring particles control the relationship. GRA

N86-26779# National Weather Service, Silver Spring, Md. Techniques Development Lab.

MOISTURE MODEL FOR THE LOCAL AFOS MOS (AUTOMA-

TION OF FIELD OPERATIONS AND SERVICES MODEL OUTPUT STATISTICS) PROGRAM
D. A. Unger Dec. 1985 49 p
(PB86-151305; NOAA-TM-NWS-TDL-77) Avail: NTIS HC A03/MF A01 CSCL 04B

The moisture model used for the Local AFOS MOS Program (LAMP) is described. The model predicts the degree of saturation in the single layer between 1000 and 500 mb by a moisture parameter known as the saturation deficit. Moisture is advected under the assumption that no evaporation or condensation occurs along the trajectory. The thickness and elevation of the advected air column determine the degree of saturation. Precipitation is forecast when the air column is saturated. The model forecasts for instantaneous precipitation were compared to those of persistance and advection of initial precipitation. GRA

N86-26780# National Weather Service, Garden City, N.Y.
LAWEB (LAKE WEATHER BROADCAST): DATA PROCESSING FOR THE GREAT LAKES
W. C. Randel and M. R. Peroutka Mar. 1986 96 p
(PB86-176658; NOAA-NWS-ERCP-36) Avail: NTIS HC A05/MF A01 CSCL 04B

A program is described which gathers all of the available observations on the Great Lakes and presents them in two, unified formats. The first format is a broadcast text which is read over the Great Lakes VHF radio system every six hours during the shipping season. The text contains wind and wave reports as well as weather and visibility when the visibility is less than four miles. The second format is that of a standard AFOS plot file, complete with sea level pressure, temperature, dew point, water temperature and wave height, when available. National Weather Service (NWS) offices can produce customized graphic displays and analyses from this file using the PMOD system of programs and various mesoscale analysis routines. A great effort has been made to produce a program which will allow major revisions of the output products without altering the FORTRAN code. GRA

N86-26781# National Severe Storms Forecast Center, Kansas City, Mo.
SEVERE THUNDERSTORM CASES OF 1985
J. E. Hales and H. G. Crowther Feb. 1986 61 p
(PB86-174125; NOAA-TM-NWS-NSSFC-11) Avail: NTIS HC A04/MF A01 CSCL 04B

Severe thunderstorms occurrences are relatively infrequent in much of the United States. Realizing the importance that experience plays and difficulty involved for a meteorologist to study past cases, a summary was compiled of all the organized severe thunderstorm episodes of June 1985. Included in each case were the times and locations of the severe weather along with specifics of the more noteworthy events. The objective was to give an overview to a forecaster as to what ingredients went into severe development with a more detailed analysis being left up to the reader. GRA

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

N86-26782*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OBJECTIVE ANALYSIS OF TIDAL FIELDS IN THE ATLANTIC AND INDIAN OCEANS
Braulio V. Sanchez, Desiraju B. Rao (National Meteorological Center, Washington, D.C.), and Stephen D. Steenrod (Applied Research Corp., Landover, Md.) Jun. 1986 25 p refs
(NASA-TM-87773; NAS 1.15:87773; Rept-86B0195) Avail: NTIS HC A02/MF A01 CSCL 08C

An objective analysis technique has been developed to extrapolate tidal amplitudes and phases over entire ocean basins using existing gauge data and the altimetric measurements which are now beginning to be provided by satellite oceanography. The technique was previously tested in the Lake Superior basin. The method has now been developed and applied in the Atlantic-Indian ocean basins using a 6 deg x 6 deg grid to test its essential features. The functions used in the interpolation are the eigenfunctions of the velocity potential (Proudman functions) which are computed numerically from a knowledge of the basin's bottom topography, the horizontal plan form and the necessary boundary conditions. These functions are characteristic of the particular basin. The gravitational normal modes of the basin are computed as part of the investigation, they are used to obtain the theoretical forced solutions for the tidal constituents, the latter provide the simulated data for the testing of the method and serve as a guide in choosing the most energetic modes for the objective analysis. The results of the objective analysis of the M2 and K1 tidal constituents indicate the possibility of recovering the tidal signal with a degree of accuracy well within the error bounds of present day satellite techniques. Author

N86-26783*# Alaska Univ., Anchorage.
INFLUENCE OF THE YUKON RIVER ON THE BERING SEA Progress Report
K. Dean and C. P. McRoy 1986 12 p refs Original contains color illustrations
(Contract NAS5-28769)
(NASA-CR-177310; NAS 1.26:177310) Avail: NTIS HC A02/MF A01 CSCL 10C

The relationships between the discharge of the Yukon River to the currents and biological productivity in the northern Bering Sea were studied. Specific objectives were: to develop thermal, sediment, and chlorophyll surface maps using Thematic Mapper (TM) data of the discharge of the Yukon River and the Alaskan Coastal Current during the ice free season; to develop a historical model of the distribution of the Yukon River discharge and the Alaskan Coastal Current using LANDSAT Multispectral band scanner (MSS) and NOAA satellite imagery; and to use high resolution TM data to define the surface dynamics of the front between the Alaskan Coastal Current and the Bering Shelf/Anadyr Current. LANDSAT MSS, TM, and Advanced Very High Resolution Radiometer (AVHRR) data were recorded during the 1985 ice free period. The data coincided with shipboard measurements acquired by Inner Shelf Transfer and Recycling (ISTAR) project scientists. An integrated model of the distribution of turbid water discharged from the Yukon River was compiled. A similar model is also being compiled for the Alaskan Coastal and Bering Shelf/Anadyr water masses based on their thermal expressions seen on AVHRR imagery. B.G.

N86-26784# Pacific Missile Test Center, Point Mugu, Calif.
TIDAL AND LUNAR DATA FOR POINT MUGU, SAN NICHOLAS ISLAND, AND THE BARKING SANDS AREA DURING 1986 Annual Report
Rich Dixon 31 Dec. 1985 40 p
(AD-A163249; PMTC-TP-00035) Avail: NTIS HC A03/MF A01 CSCL 08/3

Basic lunar and tidal data for Point Mugu, San Nicolas Island, and the Barking Sands Area during 1986 are provided. The data presented are (1) tidal data, (2) times of moonrise and moonset, (3) times of lunar phases, and (4) times of sunrise and sunset. GRA

N86-26785# Scripps Institution of Oceanography, La Jolla, Calif. Marine Physical Lab.
INFRASONIC AMBIENT OCEAN NOISE SPECTRA FROM FREELY DRIFTING SENSORS Summary Report
Richard L. Culver 30 Oct. 1985 51 p
(Contract N00014-82-K-0147)
(AD-A163413; MPL-U-52/85; SIO-REF-85-22) Avail: NTIS HC A04/MF A01 CSCL 08/10

Self-contained Swallow Floats can record very low frequency (VLF) ambient ocean noise over extended periods of time. The autonomous buoys measure and record the components of particle velocity in the 1-10 Hz band. They can be ballasted to neutral buoyancy at a desired depth. The buoys generate and

receive high frequency acoustic signals which may be used to determine their relative positions. The deployment of several of these units forms a freely drifting array of sensors. Individual element time series may be combined coherently off-line using a beamformer, e.g., the MPL dynamic Beamformer. The Swallow float design minimizes self-noise which can limit accurate ambient ocean noise measurements. The floats drift freely and are not subject to flow noise or cable strumming. They measure particle velocity and are therefore insensitive to variations in local pressure. MPL has conducted Swallow float deployments annually since 1982. The 1982 deployment tested only the acoustic positioning system. Between 12 and 14 July 1983, three Swallow floats were deployed at a location approximately 50 miles west of San Diego, California and southeast of San Clemente Island (32'N, 118'W). Sea state during the deployment varied between 1 and 2. Water depth was approximately 1900 meters. Two of the floats deployed to a depth of about 1400 meters and the third deployed to the bottom. Measurements recorded by float 3 which deployed to 1400 meters have been analyzed and results are reported. GRA

N86-26786# Naval Postgraduate School, Monterey, Calif.
CHANGES IN THE OCEAN MIXED LAYER FOLLOWING EXTRAORDINARY ATMOSPHERIC FORCING M.S. Thesis
Theodore R. Mettlach Dec. 1985 95 p
(AD-A164703) Avail: NTIS HC A05/MF A01 CSCL 08/10

A one dimensional ocean planetary boundary layer model is used to predict the evolution of the thermal structure of the ocean mixed layer at six locations in the ocean following the hypothetical effects on the atmosphere of a major nuclear war. The inputs to the ocean model are the heat and momentum fluxes computed from a 3D climate model designed to simulate nuclear winter effects in the atmosphere. The experiment gives evidence that the summertime mixed layer can cool 5 C within 30 days and that the effect of increased wind along coastal regions due to sudden ocean-land temperture differences will deepen the mixed layer 20 to 30 meters. The scientific literature on the subject of nuclear winter is reviewed and interpreted to trace the evolution of the nuclear winter hypothesis and to assess the quality of the results of the mixed layer experiment. GRA

N86-26787# University of Southern Mississippi, Hattiesburg.
OCEAN FRONTAL AREAS. PHYTOPLANKTON ENUMERATION AND BIOMASS ESTIMATES -- OPERATION GUIDING LIGHT (APRIL - MAY 1985) Final Report
Gary Anderson and Daniel Gustafson Jan. 1986 76 p refs
(Contract N00014-85-K-0353)
(AD-A164985; AD-E751128) Avail: NTIS HC A05/MF A01 CSCL 06/3

During the pilot field exercise for Operation Guiding Light (April to May, 1985), 39 phytoplankton samples were collected in the continental shelf slope frontal region and 72 phytoplankton samples were collected in the Gulf Stream frontal region (both survey areas are located in the western North Atlantic Ocean). Samples were obtained using either a towed underwater pumping system (TUPS) at a depth of two meters or a rosette sampler (various depths) and were preserved for subsequent analysis. For each sample we identified (to species, where possible) enumerated and estimated biomass of the phytoplankton present. GRA

N86-26788# Science Applications International Corp., College Station, Tex.
A STUDY OF SEA ICE KINEMATICS AND THEIR RELATIONSHIP TO ARCTIC AMBIENT NOISE. PART 3, SECTION 1: AMBIENT NOISE. SECTION 2: AMBIENT NOISE Final Report, Mar. 1985 - Feb. 1986
James K. Lewis and Warren W. Denner Feb. 1986 327 p
(Contract N00014-85-C-0531)
(AD-A165304; AD-E301922; SAIC-85/1950-Pt-3;
SAIC-1-425-07-356-10-Pt-3-SEC) Avail: NTIS HC A15/MF A01 CSCL 08/12

This report details the kinematic analysis of sea ice motion data collected during the Arctic Ice Dynamics Joint Experiment (AIDJEX) in the Beaufort Sea. In addition, relationships between the ice kinematic parameters and associated ambient noise are presented. These relationships were determined by an extensive correlation process between the noise and ice motion time histories. Time scales of the various modes of ice motion were calculated by season. Also, seasonal time and space scales were calculated for ambient noise at 10 Hz, 32 Hz, and 1000 Hz. Contents of this section include: Seasonal Arctic Ambient Noise Variations, Beaufort Sea, 1975-1976; Two-Dimensional Contour Maps of Arctic Ambient Noise Variations, 8-9 August 1975 (Summer); and Two-Dimensional Contour Maps of Arctic Ambient Noise Variations, 16-17 November 1975 (Fall). GRA

N86-26789# Science Applications International Corp., College Station, Tex.
A STUDY OF SEA ICE KINEMATICS AND THEIR RELATIONSHIP TO ARCTIC AMBIENT NOISE. PART 3, SECTION 3: AMBIENT NOISE Final Report, Mar. 1985 - Feb. 1986
James K. Lewis and Warren W. Denner Feb. 1986 107 p
(Contract N00014-85-C-0531)
(AD-A165305; AD-E301922; SAIC-85/1950-Pt-3-Sec-3;
SAIC-1-425-07-356-10-pt-3-2) Avail: NTIS HC A06/MF A01 CSCL 08/12

This report details the kinetic analysis of sea ice motion data collected during the Arctic Ice Dynamics Joint Experiment (AIDJEX) in the Beaufort Sea. In addition, relationships between the ice kinematic parameters and associated ambient noise are presented. These relationships were determined by an extensive correlation process between the noise and ice motion time histories. Time scales of the various modes of ice motion were calculated by season. Also, seasonal time and space scales were calculated for ambient noise at 10 Hz, 32 Hz, and 1000 Hz. Contents of this section include: Seasonal Arctic Ambient Noise Temporal Autocorrelations, Beaufort Sea, 1975-1976; Seasonal Arctic Ambient Noise Spatial Autocorrelations, Beaufort Sea, 1975-1976; Seasonal Arctic Ambient Noise Power Spectra, Beaufort Sea, 1975-1976. GRA

N86-26790# Woods Hole Oceanographic Institution, Mass.
DATA TABULATIONS AND ANALYSIS OF DIURNAL SEA SURFACE TEMPERATURE VARIABILITY OBSERVED AT LOTUS (LONG-TERM UPPER OCEAN STUDY)
Clarke M. Bowers, James F. Price, Robert A. Weller, and Melbourne G. Briscoe Feb. 1986 55 p
(Contracts N00014-76-C-0197; N00014-84-C-0134)
(AD-A165406; WHOI-86-5) Avail: NTIS HC A04/MF A01 CSCL 08/10

Air/sea measurements from the Long-Term Upper Ocean Study (LOTUS) buoy in the Sargasso Sea are analyzed to learn how the diurnal response of sea surface temperature, delta T sub s, is related to the surface heating, H, and the wind stress, S. Data are taken from the LOTUS-3 and LOTUS-5 records which span the summers of 1982 and 1983. The basic data are shown in monthly plots, and the analyzed daily values of delta T sub s, H, and S are given in tables and in figures. Analyzed data show a clear trend of delta T sub s increasing with H and decreasing with S. A best-fit, three-parameter, empirical function can account for 90% of the variance in a screened subset of the LOTUS data (172 days) and 81% of the variance of the full data set (361 days). The analyzed data are also compared with a theoretical model function now used for ocean predictions in the Diurnal Ocean Surface Layer model (DOSL) of Fleet Numerical Oceanography Center. The DOSL model function was derived from the assumption that wind-mixing occurs by a mechanism of shear flow instability. It is fully predictive and shows a parameter dependence consistent with the LOTUS data over a wide range of H and S. THE DOSL model function can account for almost as much variance as the best-fit empirical function. GRA

N86-26791# Massachusetts Inst. of Tech., Cambridge. Marine Industry Advisory Services.
REMOTE SENSING AND OCEANOGRAPHIC EQUIPMENT TECHNOLOGY: SOME PRESENT SYSTEMS AND FUTURE NEEDS, REVISED
1 Aug. 1985 24 p Sponsored by NOAA

(Grant NA84AA-D-00046)
(PB86-156502; MITSG-85-21; OPPORTUNITY-BRIEF-41) Avail: NTIS HC A02/MF A01 CSCL 08C

Satellite sensing systems offer new capabilities for obtaining synoptic data which can be used for understanding the dynamics of the ocean. While satellites have expanded our potential for exploring the ocean, they have also increased the demand for extensive in situ measurements (footprints or 'ground truth') to calibrate the remotely observed data. Used together with computer models, in situ measurements and satellite measurements provide new insights into the dynamics of the ocean, such as the motions of warm core rings north of the Gulf Stream. Modelling, satellite imagery and in situ measurements are being combined in ways which promise very significant advances in studying natural phenomena. GRA

N86-26792# Old Dominion Univ., Norfolk, Va. Dept. of Biological Sciences.
IDENTIFICATION MANUAL FOR PHYTOPLANKTON OF THE UNITED STATES ATLANTIC COAST Final Report
H. G. Marshall Jan. 1986 144 p refs
(PB86-151222; EPA-600/4-86-003) Avail: NTIS HC A07/MF A01 CSCL 08A

The phytoplankton identification manual is designed for general usage by individuals who have not had formal training in phytoplankton systematics or access to the numerous keys and taxonomic references usually necessary to identify marine phytoplankton. The manual contains 173 species, representing 9 taxonomic groups, that the author considers among the more common species found on the United States eastern coast. The user is also provided with a list of additional identification references for the major taxonomic groups, phytoplankton studies for the United States east coast, and recommended collection and preparation techniques. GRA

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N86-26793# Johns Hopkins Univ., Baltimore, Md. School of Medicine.
MACROPHAGE STRUCTURE AND FUNCTION Final Report, 1 Feb. 1982 - 31 Jan. 1985
Thomas August 19 Dec. 1985 9 p
(Contract N00014-82-K-0221)
(AD-A163314) Avail: NTIS HC A02/MF A01 CSCL 06/1

Extensive progress has been made in the identification and characterization of several proteins active in the human immune response. These results are summarized as follows: Preparation of Monoclonal Antibodies; Identification of Cell Proteins; Characterization of the Human Lymphocyte Function Antigen (HLFA); The In Vitro Formation of Multinucleated Giant Cells Induced from Monocytes by Monoclonal Anti-HLA-DR; Antibodies that Inhibit the Mixed Lymphocyte Reaction (MLR). GRA

N86-26794# Office of Naval Research, London (England).
BIOTECHNICA '85 INTERNATIONAL CONGRESS FOR BIOTECHNOLOGY
Claire E. Zomzely-Neurath 27 Feb. 1986 24 p Congress held in Hannover, East Germany, 8-10 Oct. 1985
(AD-A165415; ONRL-C-13-85) Avail: NTIS HC A02/MF A01 CSCL 06/1

The First International Congress and Exhibition, Biotechnical '85, which took place from 8 through 10 October 1985 at the Hannover Exhibition Grounds, was designed to provide an insight into the structure and growth potential of the relatively new biotechnology market. The congress, which included exhibitions, seminars, workshops, and panel discussions, focused on the commercial and industrial applications of biotechnology. The congress received support from the European Community because of its emphasis on fostering contacts between industry and academia. Over 170 companies, as well as research institutes and universities from 15 countries, disseminated information about current developments in research, laboratory equipment, and production techniques. The topics in the scientific program presented at the symposia sessions were divided into three general areas: (1) measurement of process control and development of models; (2) biocatalyst preparation, utilization, and improvement; and (3) animal and plant cell cultures. GRA

N86-26795# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
DEVELOPMENT, GROWTH AND TIME
Paul M. B. Vitanyi Aug. 1985 20 p Revised Submitted for publication
(CWI-CS-R8516; B8575498; ESA-86-97007) Avail: NTIS HC A02/MF A01

A simple mathematical model for filamentous growth and development is proposed. The model relates stereotype elemental (cellular) behavior to empirically observed overall growth curves. The sigmoidal growth curves are obtained. The separation of subjective or physiological time of the organism from objective or absolute, and the relation between them are emphasized. The underlying philosophy is related to Lindenmayer's developmental model. ESA

N86-26796 Washington Univ., Seattle.
THE ROLE OF THE OCEANS IN THE ATMOSPHERIC CYCLE OF CARBONYL SULFIDE
James Elmer Johnson 1985 111 p
Avail: Univ. Microfilms Order No. DA8529909

The magnitude of the global air-sea flux of carbonyl sulfide (OCS) was assessed. Air and seawater concentrations of OCS from the equator to the Aleutian Islands were measured. The Henry's law constant of solubility for OCS was measured in the laboratory for filtered and boiled seawater at three temperatures. These measurements show: (1) the atmospheric concentration of OCS is very constant and the latitudinal gradient, if any, is small, with a maximum gradient of 7% between 50 deg N and the equator; (2) the ocean surface layer is supersaturated with OCS and is therefore a source for the atmosphere instead of a sink; (3) there appears to be a subsurface maximum in the OCS concentration in the oceanic mixed layer in tropical waters; (4) values for the solubility of OCS in seawater are 10% lower than reported elsewhere; (5) a history of measurements of atmospheric OCS by four groups shows that any secular trend in atmospheric OCS is less than 3%/ yr; (6) the budget for atmospheric OCS is still not well understood. Dissert. Abstr.

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and weightlessness.

N86-26797* National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES
Jun. 1986 105 p
(NASA-SP-7011(285); NAS 1.21:7011(285)) Avail: NTIS HC A06/MF A01 CSCL 06E

This bibliography lists 319 reports, articles, and other documents introduced into the NASA scientific and technical information system in May 1986. Author

N86-26798# Naval Ocean Systems Center, San Diego, Calif.
MECHANISM OF ELECTROMAGNETIC ENERGY EFFECTS ON THE NERVOUS SYSTEM: VOLTAGE-CLAMP STUDY Final Report, Oct. 1981 - Sep. 1984
C. L. Brandt and N. L. Campbell Jul. 1985 69 p refs
(AD-A164653; NOSC/TR-1051) Avail: NTIS HC A04/MF A01 CSCL 06/18

Low-level microwave energy at a frequency of 2.45 GHz has

been previously observed to alter the firing frequency of Aplysia californica neurons. This study was undertaken to search out the mechanism of this microwave effect by examining the influences of microwave energy on specific ion currents across the cell membrane that influence the cell's firing frequency. Late outward K(+) current was examined and showed no statistically significant change during microwave exposure. The membrane current shape during voltage clamping (the summation of several different ionic currents) also showed no change during exposure except in one instance when exposure was concurrent with the application of Na(+) free artificial sea water. GRA

N86-26799# Boston Univ., Mass. School of Medicine.
FLUID-ELECTROLYTE-MINERAL INTERRELATIONS AS AFFECTING WORK PERFORMANCE Final Report, 18 Jun. 1984 - 1 Jul. 1985
Morteza Janghorbani Nov. 1985 39 p
(Grants DAMD17-84-G-4012; DA Proj. 3E1-62777-A-879)
(AD-A165325) Avail: NTIS HC A03/MF A01 CSCL 06/16

This is the Final Report dealing with development of stable isotope approaches for the study of water-electrolyte balance dynamics in relation to exercise in heat. This progress report describes the development of analytical chemistry of labeled water (H2O18) and rubidium as tracers for the measurement of body water and its dynamics and intracellular mass and its correlates. The methods used in these studies are based on Isotope Ratio Mass Spectrometry (IR/MS) and Inductively Coupled Plasma Mass Spectrometry (ICP/MS). It is shown clearly that both these methods can be used effectively for simultaneous measurement of body water and body rubidium and their correlates in human adults. Author (GRA)

N86-26800# Army Research Inst. of Environmental Medicine, Natick, Mass.
PERCEPTUAL AND PHYSIOLOGICAL RESPONSES DURING EXERCISE IN COOL AND COLD WATER
Michael M. Toner, Lawrence L. Drolet, and Kent B. Pandolf 1986 11 p
(AD-A165491) Avail: NTIS HC A02/MF A01 CSCL 06/19

This investigation examined the interaction of exposure to cold water stress with both perceived exertion and thermal sensation during exercise. Eight male volunteers performed arm, leg and combined arm and leg exercise for 45 min in water at 20 and 26 C. Exercise was performed at a low (n = 7) and a high (n = 8) intensity relative to the ergometer specific peak oxygen uptake (VO2 peak). In general, percent VO2 peak did not differ (p greater than 0.05) between type of exercise in either 20 or 26 C water. During low intensity exercise when power output was matched across water temperature (T sub w), percent VO2 peak was greater (P less than 0.05) in 20 C water (52%) compared to 26 C water (42%). Ratings of perceived exertion (RPE) did not differ (p greater than 0.05) between T sub w. During high intensity exercise when percent VO2 peak was matched across T sub w, RPE was low (P less than 0.01) during exercise in 20 C (X = 12.9) compared to 26C (X = 13.9). Multiple correlation analyses comparing both final RPE and thermal sensation (TS) with physiological and thermal measures were performed across type of exercise and T sub w. These data suggest that the change in oxygen uptake associated with exercise in cold water does not add to the overall perception of exertion. This perception appears to be related to cardiopulmonary variables rather than thermal measures, whereas thermal sensation is related to thermal measures and not cardiopulmonary variables. GRA

N86-26801# Institute for Perception RVO-TNO, Soesterberg (Netherlands). Thermophysiology Group.
INDIVIDUAL PARAMETERS IN THERMOREGULATORY CONTROL; A REVIEW
G. Havenith Dec. 1985 86 p Sponsored by Netherlands Central Organization TNO , Delft
(IZF-1985-26; TDCK-86-0429; ESA-86-96943) Avail: NTIS HC A05/MF A01

Variations in human thermoregulatory behavior caused by differences in sex, age, anthropometric measures, hydration state, and circadian rhythm were studied. In order of significance, factors which affect the variations are: state of acclimatization (defined by sweat characteristics); physical fitness (circulatory capacity); hydration state (plasma osmolality and volume); anthropometric measures (body surface, fat, inactive body mass); and time of day. ESA

N86-26802# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.
VISUAL PROTECTION AND ENHANCEMENT
Loughton, England Dec. 1985 230 p refs In ENGLISH and FRENCH Conference held in Athens, Greece, 22-24 Apr. 1985
(AGARD-CP-379; ISBN-92-835-0384-8) Avail: NTIS HC A11/MF A01

Vision is the preeminent sensory channel through which the aviator obtains information necessary for the control of his aircraft and the execution of his operational role. Recognizing this to be important, all reasonable and practical means of enhancing and protecting vision should be adopted. The papers presented considers not only systems for visual protection and enhancement but also addressed the basic physiological and pathological mechanisms underlying existing and future solutions. For individual titles, see N86-26803 through N86-26825.

N86-26803# Army Electronics Research and Development Command, Fort Belvoir, Va. Night Vision and Electro-Optics Lab.
IMAGE INTENSIFIERS: PAST AND PRESENT **c35**
Robert W. Verona *In* AGARD Visual Protection and Enhancement Dec. 1985 5 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

The evolution of the image intensifier is presented from the first through the third generation. Technological advancements during the past two decades, such as the microchannel plate and the gallium arsenide photocathodes, have significantly improved the image intensifier's projected life time and performance capabilities. Improved manufacturing techniques have contributed to the intensifier's extended life and expanded performance capabilities. This continued progress attests that the image intensifier continues to be a viable sensory extension helping man achieve his goal, the conquest of darkness. Author

N86-26804# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
FLIR, NVG AND HMS/D SYSTEMS FOR HELICOPTER OPERATION: REVIEW **c74**
H.-D. V. Boehm *In* AGARD Visual Protection and Enhancement Dec. 1985 27 p refs (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

In the last decade, electro-optical systems have been used successfully in military and civil applications. They extend the scope of operation of ground vehicles, helicopters and fixed wing aircraft from daytime into nighttime, with a 24 hour readiness covering even bad weather conditions. The visual aids fall into two physical categories: the image intensifiers, which amplify reflected residual light in the near infrared and the thermal imager, which detect the thermal radiation of all bodies mainly in the 8 to 12 micrometer atmospheric window for bodies with T approx. 20 C. During the last five years, the investigator has carried out helicopter flight trials at night using examples of all these visionic aids (FLIR, LLLTV, NVG, HMS/D and Direct View Optics) for piloting and observation tasks. The detection, recognition and identification range of nine different FLIR were tested in ground and laboratory tests. The evaluation of an optical sensor platform location in the helicopter nose-, roof- and mast-mounted versions, the comparison of thermal and intensifier images and the NVG compatible cockpit were topics of the tests. The optical sensors are described with their limitations and some results of the trials are given, with regard to the pilot's stress situation and eye safety. Author

N86-26805# German Army Aviation School, Bueckeburg (West Germany).
OPERATIONAL EXPERIENCES WITH NIGHT VISION GOGGLES IN HELICOPTER LOW-LEVEL FLIGHT AT NIGHT **c54**
Hermann Haidn *In* AGARD Visual Protection and Enhancement Dec. 1985 8p refs (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

The operational marginal conditions are described with regard to the threat analysis in the Central European theater. This is supplemented by a presentation of the technological and physical aspects of the available visual sensors, such as helmet mounted night vision goggles, low light level television, and forward looking infrared and their employment as pilotage aids within the helicopter cockpit. Also, a description is given of the work capabilities and limitations inherent with the employment of electro-optical vision aids. This involves a comparison of the visual capabilities of the unaided eye during low level flight with Moon illumination at night, conditions during reduced light levels, and viewing the same scene with electro-optical sensors. The requirement for glare protection within the cockpit is discussed and different solutions are represented. An exceptional and difficult problem to solve is currently presented by positive position fixing under the given circumstances. Aids and procedures to improve navigation were devised and are now successfully in use. Finally, the results of interviews with helicopter pilots, who have long term experience with the use of helmet mounted night vision goggles are discussed. Author

N86-26806# Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris (France).
EVALUATION OF HELICOPTER HELMET-MOUNTED DISPLAY MOCK-UP **c06**
Guy Santucci and Claude Valot *In* AGARD Visual Protection and Enhancement Dec. 1985 14 p refs (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

A psychophysiological investigation was conducted on a mockup to evaluate a helmet mounted FLIR display. This experiment included laboratory and inflight testing. Laboratory testing included angular visual acuity, contour perception and stereoscopic acuity. Electrooculography was used to test binocular behavior under monocular stimulation (interocular synergy, binocular rivalry, optokinetic nystagmus). Results showed decreased angular and stereoscopic acuity, and provided a better understanding of eye activity components in this situation. Inflight testing: stressful perception was evidenced during low level helicopter flight, which can be either an overestimation of distances and altitude by active pilots, or an underestimation of these parameters by passive pilots. An illusory sensation was observed under certain binocular uses of helmet mounted displays. It concerns contour vision. Hypotheses are formulated for these various sensory changes. Author

N86-26807# Naval Air Development Center, Warminster, Pa.
VISUAL AND SPECTRORADIOMETRIC PERFORMANCE CRITERIA FOR NIGHT VISION GOGGLES (NVG) COMPATIBLE AIRCRAFT INTERIOR LIGHTING **c54**
William A. Breitmaier and Ferdinand Reetz, III *In* AGARD Visual Protection and Enhancement Dec. 1985 11 p refs (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

A draft military specification for NVG-compatible aircraft interior lighting was developed. The specification is based on the utilization of a specific type of NVG, the AN/AVS-6 Aviators Night Vision Imaging System (ANVIS). The performance requirements and testing methodology established in the specification and the rationale for developing these requirements are described. The performance requirements are affected by three factors: luminance, chromaticity, and ANVIS compatibility. Luminance requirements do not change drastically from the requirements that presently exist for interior lighting. However, the chromaticity requirements of green for primary and secondary lighting, and yellow for both master caution and warning indicators are different from those that presently exist. The reason for this change is that any lighting with a significant amount of red energy cannot be used in a cockpit that is required to be ANVIS compatible. The implications for this new color design for cockpit lighting are discussed together with the rationale for the chromaticity coordinates and limits chosen. ANVIS compatibility is defined in terms of the spectral sensitivity of the ANVIS and the combination of spectral radiance of the cockpit lighting and the outside world night radiance. Quantitative testing methodology for determining ANVIS compatibility of cockpit lighting is also discussed. A thorough description of all analytic and laboratory studies performed in support of this specification development is presented. Author

N86-26808# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
NIGHT VISION SUPPORT DEVICES: HUMAN ENGINEERING INTEGRATION **c74**
Louis V. Genco *In* AGARD Visual Protection and Enhancement Dec. 1985 8 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

Although NVGs extend the luminance range over which vision can be used, current AN/PVS systems require special cockpit lighting to be fully effective, reduce visual depth of field and diminish the field of view. All three of these factors are extremely important to pilots performing night operations. The results of several operationally oriented efforts conducted by the U.S. Air Force to improve visual performance, cockpit lighting, and flight information transfer in conjunction with the use of NVGs are described. The efforts include an operational definition of NVG compatible lighting, a recommended approach to improving depth of focus, an attempt to expand field of view, and a description of a NVG HUD using optically injected flight data. All efforts center around using or modifying current AN/PVS NVGs used by US forces. Author

N86-26809# Army Aeromedical Research Lab., Fort Rucker, Ala.
MICRO-HEADS-UP DISPLAY FOR ENHANCEMENT OF NIGHT VISION GOGGLE OPERATIONS **c06**
R. Simmons, K. Kimball, and B. Hamilton *In* AGARD Visual Protection and Enhancement Dec. 1985 9 p refs (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

A series of investigations which were initiated in 1976 and completed in March 1984 by the US Army addressed the utility of providing a subminiature heads-up flight instrument display for the NVG system. The research first attempted to identify critical flight information that should be provided to supplement the degraded environmental cues during NVG operations. Subsequent research explored methods of presentation (digital vs. dynamic information), in-line mounting of the display to NVG, and in-flight human factor considerations of the total system. Author

N86-26810# Army Aeromedical Research Lab., Fort Rucker, Ala.
AEROMEDICAL LESSONS LEARNED WITH NIGHT VISION DEVICES
Dudley R. Price and William E. McLean *In* AGARD Visual Protection and Enhancement Dec. 1985 10 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

A review of night vision devices used in the military helicopter flight environment is presented, along with aeromedical lessons learned. Discussion revolves around experience with three U.S. Army aviation systems: the currently used second-generation night vision goggle (NVG), or AN/PVS-5; the soon-to-be-fielded AN/AVS-6 third-generation NVG; and the AH-64 Apache thermal sensor and imaging system. Performance characteristics are presented, and primary emphasis is on aeromedical research related to pilot interface with the systems to include visual acuity, contrast sensitivity, depth discrimination, dark adaptation, crew fatigue, and adaptational problems. Author

N86-26811# Marconi Avionics Ltd., Rochester (England). Airborne Display Div.
NIGHT VISION BY NVG WITH FLIR **c74**
G. C. Bull *In* AGARD Visual Protection and Enhancement Dec.

1985 7 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

Night Vision Goggles and fixed forward looking infrared equipment both have particular operational shortcomings when used in a fixed wing aircraft for close air support at night. However, when operated together, they compensate for each others deficiencies forming a highly capable system at far less cost and complexity compared with other night vision systems. Author

N86-26812# Hamburg Univ. (West Germany). Dept. of Ophthalmology.

PARTICULAR PROBLEMS OF AIRWORTHINESS FROM AN OPHTHALMOLOGICAL VIEW

J. Draeger, K. Hanke, and H. Wirt *In* AGARD Visual Protection and Enhancement Dec. 1985 3 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

Navigation of aircrafts depends on visual acuity and optical perception in the main. Therefore ophthalmological evaluation is of major importance in aviation medicine. Each country uses its own national medical standards for the three different pilot classes. But there still remain applicants not exactly meeting these standards. In West Germany, a special expert board is competent for these borderline cases in civil aviation. Some examples are given from the practice of this board showing the particular problems of appropriate decisions. Also the major differences of national regulations between West Germany and the USA are discussed, comparing civil and Air Force standards. Author

N86-26813# Letterman Army Inst. of Research, San Francisco, Calif.

COMPUTER VISUAL SIMULATION OF CONTRAST SENSITIVITY DEFICITS INDUCED BY LASER AND CHEMICAL ANTIDOTE EXPOSURE c54

H. Zwick, D. Monroe, and L. Sherman *In* AGARD Visual Protection and Enhancement Dec. 1985 4 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

Training in some complex combat related tasks may produce a degree of transient visual impairment which may simulate what could be expected in combat. A method is presented for simulating visual impairment produced by potential combat conditions. The use of a computer to both digitize and store as well as produce the simulated image has provided an ideal tool for research. The degree of realism provided by such simulation offers suggestions for development of more realistic training techniques Author

N86-26814# Hamburg Univ. (West Germany). Dept. of Ophthalmology.

NEW GLASSES FOR PRESBYOPIC PILOTS

J. Draeger, H. Wirt, and K. Hanke *In* AGARD Visual Protection and Enhancement Dec. 1985 3 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

Presbyopia is a physiological condition starting by an age of about 40 and increasing steadily with age until accommodation ceases around 55. This means that the naked eye is not able to read instruments and charts in near distance. In a fighter cockpit the information of the head-up display is projected on to the windscreen. Therefore, the pilot has to share his attention between infinity and the projected image of the head-up display, focussing and defocussing very quickly between both distances, always looking straight. This reaction slows down with age. In an experimental study an attempt was made to investigate this complex problem and to test certain solutions. A group of untrained presbyopic subjects were asked to perform specifically designed tasks of assembling small parts and were fitted with different multifocal glasses. In three different ranges and different levels, approximately according to the distance in a cockpit, they had to differentiate and to grasp small electronic elements and to fix them on an electronic plate. The time needed and the mistakes were noted and compared. The evaluation showed much better results for those subjects which had with their glasses the greatest visual field for each specific range and level. E.R.

N86-26815# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

CONTACT LENSES FOR PILOTS AND AIRCREW IN THE SERVICES

J. K. Cloherty *In its* Visual Protection and Enhancement Dec. 1985 12 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

After working for five years in the contact lens department of Moorsfields Eye Hospital in London and after fitting and monitoring forty volunteers in the RAF Aircrew Soft Contact Lens Trial, it is the opinion of the author that high water content soft contact lenses, or silicone lenses, used as extended wear lenses, are the only contact lenses which are suitable in an aircrew service environment. The fitting and monitoring of such lenses must be carried out by experts in the field of contact lenses. Author

N86-26816# National Aerospace Medical Centre, Soesterberg (Netherlands).

DYNAMIC BEHAVIOUR OF SPHERICAL AND ASPHERICAL CONTACT LENSES EXPOSED TO +Gz-ACCELERATION FORCES c54

H. Punt, A. C. H. vandenHeuvel, H. H. vandenBiggelaar (Royal Netherlands Air Force, The Hague.), G. J. Hoekstra, and A. J. P. Rouwen (Militair Hospitaal Dr. A. Mathijsen, Utrecht (Netherlands).) *In* AGARD Visual Protection and Enhancement Dec. 1985 5 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

A study was made of the behavior of two types of hard contact lenses fitted to a young myopic pilot and exposed to +Gz-acceleration forces. The degree of dislocation of the hard lenses was studied as was the pathological phenomena of the cornea under increasing +Gz-forces. The two types of the evaluated contact lenses are a conventional spherical polymethylmethacrylate (PMMA) lens and an aspherical gas-permeable lens. In a human centrifuge a test person was exposed to +Gz-forces increasing from +1 to +9 Gz. In the gondola a videotelecamera was focussed at the head of the test person during the total test session. It could be concluded that the aspherical gas-permeable contact lenses maintained an optimal concentration under all circumstances. The conventional hard contact lenses with a spherical base curve and a smaller diameter showed downward decentration under increasing +Gz-loads from +6 Gz to a peak value of 8.6 Gz. However, the dislocation never caused the contact lens to leave the cornea. The results are discussed in relation to practical consequences for pilot flying high performance aircraft. Author

N86-26817# Letterman Army Inst. of Research, San Francisco, Calif.

EFFECTS OF BROAD-BANDED EYE PROTECTION ON DARK ADAPTATION

H. Zwick, T. A. Garcia, E. S. Beatrice, and K. R. Bloom *In* AGARD Visual Protection and Enhancement Dec. 1985 8 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

Modern combat scenarios require soldiers to perform military tasks under night time conditions. While image enhancement devices are vital to such military performance, unimpaired human night vision retinal mechanisms are essential for performance success. Protection of the human biological sensor is of utmost importance. In this investigation, earlier findings indicating that sunglasses could prevent deleterious effects of bright light on dark adaptation are reexamined. It was found that the use of broad band attenuating spectacles could improve absolute visual thresholds but they had minimal effect on central retinal mechanisms. Dark adaptation functions measured with long wavelength light showed no significant sunglass effect; whereas, such functions measured with intermediate spectral light decreased in final visual thresholds. These differential effects were obtained under environmental light conditions insufficient to produce an evaluation in final visual thresholds for control group subjects not provided with

sunglasses. The results strongly support previous arguments for providing standard visible and near ultraviolet protection to personnel required to perform military tasks under extremely bright environmental light. Author

N86-26818# School of Aerospace Medicine, Brooks AFB, Tex.
EYE PROTECTION AGAINST INTENSE LIGHT SOURCES
Donald N. Farrer *In* AGARD Visual Protection and Enhancement Dec. 1985 3 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

The assessment of modern techniques for the protection of the eyes against laser radiation must begin with the careful evaluation of these stimuli within the context of impairment of useful work. Occupational safety and health standards were designed to define exposure limits of laser systems to prevent damage. However, an eye hazard may not exist within some exposure conditions (e.g., glare, dazzle, or reversible scotoma) in which functional vision impairment could result in job performance failures. Additionally, eye protection devices should not induce impairment properties. It is within this context that this research program was designed. The identification of laser threats, effects on functional vision and eye protective device properties are important considerations for successful aircrew performance. The vast array of intense light sources which represent threats to functional vision, introduces significant challenges for this research area. Author

N86-26819# WWDBw ABC-Schutz, Munster (West Germany).
CALCULATIONS ON TECHNICAL REQUIREMENTS FOR PROTECTION DEVICES AGAINST A NUCLEAR LIGHT FLASH
W. Rehmann and H. Sesterhenn *In* AGARD Visual Protection and Enhancement Dec. 1985 11 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

Preliminary calculations on the requirements for protective devices against permanent retinal burns caused by nuclear detonations were based on a simplified model which was also used for this study. Computations concerning the reversible flash blindness of flight crews caused by a nuclear explosion is studied as well as the resultant technical requirements to be met by antiflash eye protection systems. In the low yield nuclear range the computations led to shutter times which are technically unfeasible at the present time. Therefore, additional computations were made to determine the periods of blindness occurring when technically feasible antiflash eye protection systems are used. They were then compared with the periods of blindness to be expected under identical conditions but without antiflash eye protection systems. Author

N86-26820# WWDBw ABC-Schutz, Munster (West Germany).
GERMAN DEVELOPMENT OF A LC-FLASHBLINDNESS DEVICE c74
W. Rehmann and H. Sesterhenn *In* AGARD Visual Protection and Enhancement Dec. 1985 6 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

A research program was conducted on the feasibility of flash blindness protection by liquid crystal techniques. The result was the development of a reversible fast optical shutter basically consisting of a liquid crystal cell enclosed in 2 crossed polarizers, which provided promising data for an application for flash blindness protection. Shutter times were in the range of 50 to 80 microseconds, an open state transmittance of 0.25 to 0.30 is state of the art. The closed state transmittance amounts to .0001 to .00001. Author

N86-26821# Naval Air Development Center, Warminster, Pa. Life Sciences Research Group.
THE APPLICATION OF DIFFRACTION OPTICS TECHNIQUES TO LASER EYE PROTECTION
Gloria T. Chisum *In* AGARD Visual Protection and Enhancement Dec. 1985 4 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

Development of a method of protecting the eyes of military personnel from laser radiation has been pursued for a number of years. The devices developed have marginal acceptability, particularly for aircrew personnel. Efforts underway to develop a holographic diffraction grating protection device indicate that such a device is feasible and that the requirements of high transmittance, multiple wavelength rejection and configuration suitable for aircrew use can be met. Author

N86-26822# Letterman Army Inst. of Research, San Francisco, Calif.
FOVEAL FLASHES AND HUMAN PERFORMANCE
D. I. Randolph, E. T. Schmeisser, and E. S. Beatrice *In* AGARD Visual Protection and Enhancement Dec. 1985 6 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

The role of several variables in the production of a flash which would reduce the ability of humans to detect and discriminate targets, functions which are required of both air and ground troops is determined. Four volunteers were exposed to xenon gas discharge tubes with different retinal spot sizes and flash durations. The task consisted of a reaction time experiment in which the subjects detected both the presence and orientation of a striped grating which subtended 0.57 deg at the retina. Three grating contrasts at three pattern-background contrasts were presented in a pseudo random order. Three flash conditions were used. The results showed that the larger image size and longer flash durations produced significantly poorer performance on both the detection and discrimination tasks. For the smallest retinal spot size, and the shortest flash condition, the detection but not the discrimination times were faster than the nonflash trials. This indicated that while the flash may have acted as a preparatory signal, more complex pattern processing remained sensitive to the flash. Author

N86-26823# Letterman Army Inst. of Research, San Francisco, Calif.
PERMANENT VISUAL CHANGE ASSOCIATED WITH PUNCTATE FOVEAL LESIONS
H. Zwick, K. R. Bloom, and E. S. Beatrice *In* AGARD Visual Protection and Enhancement Dec. 1985 8 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

In order to understand battlefield hazards of laser exposure under field conditions, it has been necessary to evaluate effects of small punctate foveal lesions on visual function of nonhuman primates. Previous experiments have found a correlation between functional loss and foveal damage. The present investigation showed that detecting the effects of small foveal lesions is not an easy task. From the results, the possibility that considerable foveal damage could occur before a measurable change in visual function could be detected with presently available visual function testing procedures is apparent. It is recommended that more sensitive visual function test procedures, such as clinical tests that measure both spectral and spatial resolution under threshold contrast conditions. Author

N86-26824# British Aerospace Public Ltd. Co., Kingston-upon-Thames (England). Systems Engineering Dept.
VISUAL DIFFICULTIES ASSOCIATED WITH FUTURE WINDSCREEN AND HUD INTEGRATION c74
A. J. Hulme and K. F. Shrubb *In* AGARD Visual Protection and Enhancement Dec. 1985 9 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

The integration of a binocular HUD and the windscreen requires the consideration of a number of optical parameters if the HUD symbology is to be superimposed on the real world scene without giving rise to unacceptable visual difficulties. These parameters are described as are the causes of these difficulties, and a number of experiments carried out during these investigations are reported. The significance of these results for future aircraft and their operations is discussed. Author

N86-26825# British Aerospace Public Ltd. Co., Lancashire (England). Cockpit Specialist Group.
HUMAN FACTORS: THE CINDERELLA DISCIPLINE IN COCKPIT INTERFACE DESIGN **c54**
K. W. Martin and J. Laycock (Royal Aircraft Establishment, Farnborough, England) *In* AGARD Visual Protection and Enhancement Dec. 1985 10 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

The present trend in military aircraft design towards compact cockpits, multifunction controls and displays, and integrated systems within more agile and smaller airframes, has resulted in a greater need for human factors involvement in the design of the man machine interface. The cockpit of the modern military aircraft is inevitably a compromise of conflicting design disciplines, and one in which human factors fails to achieve any long term influence because the discipline lacks the absolute argument necessary for survival in the industrial environment. If human factors are to establish the degree of influence the current levels of research justify, then a new approach is necessary. This approach must recognize the practical problems associated with the design and manufacture of the integrated weapons delivery system that future aircraft represent. One possible approach may be the generation of human factors design tools, for use by engineers, which incorporate human sensory emulations and provide outputs that can be integrated into the engineering discipline. Author

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N86-26826 Groningen Rijksuniversiteit (Netherlands). Traffic Research Center.
DRIVING PERFORMANCE THE DAY AFTER USE OF LOPRAZOLAM, FLUNITRAZEPEM AND PLACEBO
E. R. Volkerts, G. deVries, T. Meijer, and J. F. OHanlon Jun. 1984 66 p Revised Sponsored in part by Netherlands' Ministerie van Onderwijs en Weitenschappen and Roussel-UCLAF, France
(VK-83-04; ISBN-90-6807-005-3; B8561714; ISSN-0167-8590; ESA-86-96948) Copyright. Avail: Issuing Activity

In order to determine if loprazolam, a mild hypnotic drug, has residual effects on driving performance and if a dose-effect relationship exists, 16 female subjects performed a driving test in 1 of 4 conditions. Loprazolam was administered in doses of 1 mg and 2 mg in conditions 1 and 2; flunitrazepam in a dose of 2 mg was administered as the active drug control in the third condition; and a placebo was given in the fourth condition. Nightly doses of loprazolam 1 mg and flunitrazepam 2 mg can slightly degrade driving performance the following day, but the degree of impairment seems insufficient to preclude the drugs' use by drivers. Nightly doses of loprazolam 2 mg can seriously degrade driving performance for up to 17 hours and this dose is not recommended for use by drivers. ESA

N86-26827 Groningen Rijksuniversiteit (Netherlands). Traffic Research Center.
THE EFFECTS OF THE ANTIDEPRESSANTS OXAPROTILINE, MIANSERIN, AMITRYPTILINE AND DOXEPIN UPON ACTUAL DRIVING PERFORMANCE
Jan Willem Louwerens, Karel A. Brookhuis, and James F. OHanlon Jun. 1984 77 p Sponsored in part by Netherlands' Ministerie van Onderwijs en Wetenschapsbeleid and Ciba-Geigy AG, Basle, Switzerland
(VK-83-05; ISBN-90-6807-006-1; B8561711; ISSN-0167-8590; ESA-86-96949) Copyright. Avail: Issuing Activity

The effects of antidepressants and a placebo were compared using a driving test. Five treatments were administered to 20 healthy young male volunteers on separate days, spaced at least 5 days apart. These were: oxaprotiline, amitryptiline and doxepin 75 mg (25 mg tid); mianserin 30 mg (10 mg tid); and placebo. Doses of each drug and placebo were administered 10, 6, and 2 hours before tests. Oxaprotiline is generally without adverse acute effects upon driving performance, but may produce either impairment or improvement in particular individuals. Amitryptiline, mianserin and doxepin, in that order, have adverse acute effects on driving performance. Individuals suffering impairment as a consequence of antidepressants' acute effects can recognize the implications for driving safety and cease driving, while others cannot, and continue driving with progressively deteriorating performance until their safety is seriously compromised. ESA

N86-26828# Yale Univ., New Haven, Conn. Dept. of Psychology.
COMPONENTS OF VERBAL INTELLIGENCE Final Report, 1 Oct. 1982 - 30 Sep. 1985
Robert J. Sternberg 30 Dec. 1985 47 p
(Contract N00014-83-K-0013)
(AD-A163359) Avail: NTIS HC A03/MF A01 CSCL 05/10

This project develops and tests a theory of the components of verbal intelligence. Alternative theoretical frameworks for understanding verbal intelligence are reviewed, and then a componential theory of verbal comprehension is proposed. The theory specifies the information-processing components, context cues, and mediating variables underlying acquisition of word meanings from context. A number of experiments testing and supporting the theory are described, including experiments involving both internal and external context. Instructional experiments are also described, and it is concluded that the theory is well supported by the data, and moreover, that it can serve as a useful basis for training people in how to learn meanings of words from context. The theory is extended to novel kinds of concepts as well, and it is shown that the learning of novel concepts involves an interaction between linguistic and conceptual unfamiliarity. In a series of experiments on causal inference involving verbal versus symbolic-abstract materials, it is shown that although a core of logical operations is applied to both verbal and abstract materials, special processes are involved when people reason about meaningful verbal materials. GRA

N86-26829# Xerox Palo Alto Research Center, Calif.
ACQUIRING PROCEDURAL SKILLS FROM LESSON SEQUENCES Final Report, 1 Jan. 1982 - 15 Jun. 1985
Kurt A. Vanlehn 13 Aug. 1985 53 p
(Contract N00014-82-C-0067)
(AD-A164580; ISL-9) Avail: NTIS HC A04/MF A01 CSCL 05/10

This report provides an informal overview of a theory that describes how people learn certain procedural skills, such as arithmetic and algebra, from multi-lesson curricula. The central hypothesis is that students and teachers obey conventions that cause the goal hierarchy of the acquired procedure to be a particular structural function of the sequential ordering of lessons. This learning theory is an extension of Repair Theory, which describes how people mix interpretation and a certain type of meta-level problem solving as they try to solve practice problems. The learning theory has been embedded in a program that generates detailed predictions about the products of published curricula. The predictions have been tested against data from several thousand mathematics students. GRA

N86-26830# Naval Postgraduate School, Monterey, Calif.
CHANGES IN NAVAL AVIATION BASIC INSTRUMENT FLIGHT TRAINING: AN ANALYSIS M.S. Thesis
James Y. Wallace, III Dec. 1985 108 p
(AD-A164738) Avail: NTIS HC A06/MF A01 CSCL 05/9

This thesis evaluates a modification to the Navy's Basic Instrument flight instruction, the performance of two groups of student aviators was compared. The modifications consisted of a lecture concentrating on the fundamentals of attitude instrument flight. One group of 100 students received the new training while a control group of 100 students did not. Analysis of the flight grades of the two groups revealed no significant difference in

their performance. Based on the results of this research it was concluded that the modified basic instrument training did not improve the performance of student naval aviators. However, the modified lecture and training did improve the student's understanding of basic instrument fundamentals. The study recommended that the modified lecture should be continued as part of the syllabus because the benefits from affording the student aviators with additional training exceed the small costs involved. ign, Flight skills acquisition. GRA

N86-26831# Vanderbilt Univ., Nashville, Tenn. Dept. of Psychology.
INTERACTION OF IMAGE CHARACTERISTICS OF STEREOSCOPIC FORMS DURING DEPTH PERCEPTION Final Report, 1 Oct. 1980 - 30 Jun. 1984
Robert Fox Aug. 1985 35 p refs
(Contract N00014-81-C-0001)
(AD-A164895; N14-0001-85C-0001) Avail: NTIS HC A03/MF A01 CSCL 06/16

The primary objective of this research program was to determine the degree of congruence between the apparent or perceived depth position of a stereoscopic form and the position predictable from the physical conditions of stimulation. This topic, which bears directly on the veridicality or validity of depth information presented in a stereoscopic or 3-d display, has been investigated previously under restricted laboratory conditions that yield results of limited generality. For that reason, the present inquiry was pursued under naturalistic conditions similar to those that would obtain during the routine operation of visual displays. To gain insights into potential interactions between depth position (X-axis) and stimulus configuration (X- and Y-axes), stereoscopic forms were created from dynamic random element stereograms continuously generated electronically. This approach precluded the occurrence of non-stereoscopic cues that can arise in conventional depth displays. GRA

N86-26832# School of Aerospace Medicine, Brooks AFB, Tex.
THE HEALTHY MOTIVATION TO FLY: NO PSYCHIATRIC DIAGNOSIS Final Report, 1 Jul. - 31 Aug. 1985
Robert R. Adams and David R. Jones Nov. 1985 15 p refs
(AD-A164944; USAFSAM-TR-85-77) Avail: NTIS HC A02/MF A01 CSCL 05/10

Aircrew mission effectiveness may uniquely be influenced by subtle psychological factors, not ordinarily brought to the attention of psychiatrists. Pilots tend to be bright, articulate, and anxious to resume their aviation duties when grounded. However, these patients are usually well defended, and rarely psychologically attuned or introspective. Greater insight into what constitutes the normal, healthy motivation to fly will help those who make judgements regarding the return of grounded aviators to flying duty. A review of associated birth order, personality theory, industrial and business psychology, aerospace, and psychoanalytic literature is presented. Highlighted are the difficulties inherent in examining the motivation of a healthy, well-defended population. Our conclusion: an examiner's countertransferential feelings are the best available tool for measurement of healthy motivation. GRA

N86-26833# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Psychology.
THE ROLE OF ELABORATIONS IN INSTRUCTIONAL TEXTS: LEARNING TO USE THE APPROPRIATE PROCEDURE AT THE APPROPRIATE TIME Technical Report, Jan. - Oct. 1985
Davida H. Charney 14 Feb. 1986 85 p
(Contracts N00014-84-K-0063; NR Proj. RR0-4206)
(AD-A165211; TR-86-2-ONR) Avail: NTIS HC A05/MF A01 CSCL 05/9

This research investigates the kinds of information that should be included in instructional texts that teach skills (such as manuals or textbooks). It focuses on an important subcomponent of skill learning: choosing the right procedure at the right time. Learning to choose the right procedure is difficult in skills such as using a computer because the connection between real-world goals and the generic procedures described in a manual is often obscure. Furthermore, when several procedures have similar functions, it is difficult to tell which one is best for a particular situation. In order to facilitate the decision process, instructional tests may include advice about when to use particular procedures and may illustrate the advice with examples. The research reported here investigated the effect of various forms of advice on learners' strategies for choosing a procedure. Subjects read one of four versions of a manual for a computer game called Box-World. Three versions contained advice about when to use particular game procedures; the advice was either stated as a simple verbal rule or elaborated with one of two types of examples. The fourth version contained no advice. Subjects then performed three tasks: a recall task, a recognition task (i.e., discriminating between correct and incorrect applications of the advice), and a decision task (i.e., solving problems for which the advice was relevant). Author (GRA)

N86-26834# Groningen Rijksuniversiteit (Netherlands). Traffic Research Center.
FLURAZEPAM HCL'S RESIDUAL (HANGOVER) EFFECTS UPON ACTUAL DRIVING PERFORMANCE
J. F. OHanlon, E. R. Volkerts, G. deVries, A. vanArkel, M. Wiethoff, and T. Meijer Nov. 1984 58 p Revised Sponsored in part by Netherlands' Ministerie van Onderwijs en Wetenschapsbeleid and F. Hoffmann-La Roche and Co., Ltd., Basle, Switzerland
(VK-83-02; B8462753; ISBN-90-353-0030-0; ISSN-0167-8590; ESA-86-96947) Avail: NTIS HC A04/MF A01

The effects on driver performance of taking a hypnotic drug (flurazepam HCL) were assessed on 40 female subjects aged between 25 and 40. An acute experiment wherein a larger group's performance was assessed following 2 nights of drug or placebo treatment; and a subchronic experiment wherein a smaller group's performance was assessed, before, during and after 8 consecutive nights of treatment with flurazepam 30 mg were conducted. Flurazepam doses of 15 mg and 30 mg were administered in different treatment conditions of the acute experiment. Secobarbital 200 mg was administered in another condition as the active drug control, and a placebo was administered in the final condition. Flurazepam 30 mg impairs driving performance for at least 17 hours following drug intake. Flurazepam's residual effect is dose-dependent. Serious impairment can occur. ESA

N86-26835# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
A MODEL AND EXPERIMENTAL ANALYSIS OF PILOT DECISION MAKING BEHAVIOR FOR VARIOUS AUTOMATIC APPROACH CONDITIONS
R. C. vandeGraaf and P. H. Wewerinke 5 Apr. 1984 48 p
(Contracts NIVR-1857; BMFT-0101-ZA/WF/WRD-174/4)
(NLR-TR-84037-U; ESA-86-96980) Avail: NTIS HC A03/MF A01

Four experienced airline pilots monitored stabilized automatic approaches in a flight simulator, to assess a failure detection model. The tasks comprised the detection of excessive longitudinal and lateral windshears, and of system failures on the glideslope and localizer indicators. Two failure probability conditions were included to investigate the effect of the subject's failure expectancy on the detection performance. Good agreement between the model predictions and the experimental results of two subjects is obtained. The failure detection times of the two other subjects are larger, especially for the windshear conditions, due to a more conservative detection strategy. Results indicate the usefulness of an analytical capability for investigating relative effects of aircraft design parameters, such as display integrity, configuration, and format on failure detection performance. ESA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N86-26836*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

BASELINE EXPERIMENTS IN TELEOPERATOR CONTROL
Walter W. Hankins, III and Randolph W. Mixon Jul. 1986 65 p
(NASA-TP-2547; L-15963; NAS 1.60:2547) Avail: NTIS HC A04/MF A01 CSCL 05H

Studies have been conducted at the NASA Langley Research Center (LaRC) to establish baseline human teleoperator interface data and to assess the influence of some of the interface parameters on human performance in teleoperation. As baseline data, the results will be used to assess future interface improvements resulting from this research in basic teleoperator human factors. In addition, the data have been used to validate LaRC's basic teleoperator hardware setup and to compare initial teleoperator study results. Four subjects controlled a modified industrial manipulator to perform a simple task involving both high and low precision. Two different schemes for controlling the manipulator were studied along with both direct and indirect viewing of the task. Performance of the task was measured as the length of time required to complete the task along with the number of errors made in the process. Analyses of variance were computed to determine the significance of the influences of each of the independent variables. Comparisons were also made between the LaRC data and data taken earlier by Grumman Aerospace Corp. at their facilities. Author

N86-26837# Cummings Solar Corp., Wilmington, Mass.
DESIGN AND PRODUCTION OF DAMAGE-RESISTANT TRAY PACK CONTAINERS Final Report, 13 Apr. 1984 - 31 Jul. 1985
Richard D. Cummings Jul. 1985 242 p refs
(Contract DAAK60-84-C-0011; DA Proj. 1L1-62724-AH-99)
(AD-A164595; NATICK-TR-86/008) Avail: NTIS HC A11/MF A01 CSCL 06/8

The tray pack is a food container that serves the functions of food storage vessel; food heating vessel; and food serving vessel. The lid is drawn from 90-pound per base box (0.010-inch-thick) steel. The bottom or can is drawn from 90-pound per base box (0.010-inch-thick) steel. Both top and bottom have a polymeric inner linear and an outer organic coating. The cause of tray pack damage were determined to be: prestressing caused by vacuum packing and underfilling; hydrodynamic forces induced by relative fluid motion within the tray pack at the moment of impact during dropping; and denting of the thin tray body material. The inability of the tray pack shipping container to withstand stacking loads was determined to be caused by poor tolerances of the shipping containers and denting of separation pads by the tray lid sealing seam. Test results show that damage can be prevented by avoiding vacuum packing, making the tray packs from 98-pound material, using a tray pack design employing reinforcing beads, using pads that nest within the sealing seam of the tray pack, and packing the tray packs so that the lids of the bottom two face down and top two face up. Test results also show that unit loads of tray packs can be stacked four high by using a properly dimensioned telescoping shipping container, the nesting pads and the two-up, two-down packing technique. GRA

N86-26838# Anthropology Research Project, Yellow Springs, Ohio.
DEMOGRAPHIC AND ANTHROPOMETRIC ASSESSMENT OF US ARMY ANTHROPOMETRIC DATA BASE Interim Report, Sep. 1984 - Apr. 1985
Bruce Bradtmiller, Jyoti Ratnaparkhi, and Tebbetts, Ilse Aug. 1985 83 p
(Contract DAAK60-84-C-0086; DA Proj. 1L1-62723-AH-98)
(AD-A164637; NATICK-TR-86/004) Avail: NTIS HC A05/MF A01 CSCL 05/2

It has been nearly 20 years since the last anthropometric survey of Army males was conducted and about eight years since the last survey of Army females. The purpose of this report is to assess the extent to which the Army's existing anthropometric data base is representative of the current Army active duty force, both demographically and anthropometrically. The demographic variables of age, sex, and race are compared for the Army's existing anthropometric data base, the current active duty force, and the projected force of the 1990s. The changes in these variables occurring in the Army population are also contrasted with those occurring in the U.S. population at large. The anthropometric variables of stature and weight are compared for the existing data base and current active duty officers. Other anthropometric variables that are affected by race and age are also examined. Differences in anthropometric variables between the existing data base and the current active duty force are discussed in the context of secular trends in anthropometric measures from the U.S. population at large and other military populations. The implications of using the Army's existing anthropometric data base in the design and sizing of clothing and personal equipment are examined in light of the present and projected demographic composition of the Army active duty force. GRA

N86-26839# Materials Research Labs., Ascot Vale (Australia).
A LIGHTWEIGHT IMPERMEABLE SUIT FOR CHEMICAL PROTECTION IN WARM CONDITIONS: A PRELIMINARY LOOK AT THE CONCEPT
R. I. Tilley, Jill M. Standerwick, Geoffrey J. Long, and Hugh D. Crone Aug. 1985 22 p refs
(AD-A164687; MRL-R-972) Avail: NTIS HC A02/MF A01 CSCL 15/2

A lightweight overgarment made of spun-bonded polyethylene was compared with the UK No. 1 Mk 3 NBC suit in terms of the heat burden imposed on wearers. The physiological responses of volunteers exercising in warm conditions were measured for both clothing ensembles and were found to be similar. These results suggested that the concept of a lightweight impermeable NBC suit for wear in jungle conditions was worthy of close investigation. Results also confirmed previous observations that soldiers wearing NBC clothing in warm and humid conditions could do little more than adopt a defensive position if they were not to become heat stress casualties. GRA

N86-26840# Pattern Analysis and Recognition Corp., McLean, Va.
HUMAN FACTORS IN RULE-BASED SYSTEMS Final Report
Paul E. Lehner, Debra Zirk, Richard B. Hall, and Leonard Adelman 14 Oct. 1985 30 p refs
(Contract N00014-83-C-0537)
(AD-A165309; AD-E301922; PAR-85-109) Avail: NTIS HC A03/MF A01 CSCL 05/8

This report summarizes several experiments investigating the impact of mental models and cognitive consistency on user/expert system interaction. Results indicate that user/expert system combined problem solving performance significantly improves if the user has a good mental model of expert system processes. Furthermore, cognitive consistency between the user and system problem solving procedures only degrades performance in situations where users do not have a good mental model. Some practical implications of this research is discussed.
Author (GRA)

N86-26841# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
SOLDIER-COMPUTER INTERFACE Final Report
30 Nov. 1985 215 p
(AD-A165326; TOP-1-1-059) Avail: NTIS HC A10/MF A01 CSCL 05/5

The material in this TOP is intended to be used for the Human Factors Engineering (HFE) Evaluation of the Soldier-Computer Interface (SCI) of systems tested by TECOM. It encompasses procedures for an HFE Analysis and walk-through, mission simulation, and interview guide. Included are criteria in the form of checklists. GRA

N86-26842# School of Aerospace Medicine, Brooks AFB, Tex.
METHODOLOGY FOR INTEGRATION TESTING OF AIRCREW CLOTHING AND EQUIPMENT Final Report, Aug. 1982 - Dec. 1984
Peter H. R. Gill Dec. 1985 19 p refs

(AD-A165328; USAFSAM-TR-84-19) Avail: NTIS HC A02/MF A01 CSCL 06/17

This report recommends a comprehensive range of tests for the integration and viability of an aircrew personal protective ensemble (PPE) or an item of PPE for use in an aircraft. It is emphasized that these tests are additional to any type test schedules for individual items of PPE. A test described in this report should be completed satisfactorily before the item or assembly is submitted for flight test evaluation. GRA

N86-26843# Pattern Analysis and Recognition Corp., McLean, Va.
MENTAL MODELS AND PROBLEM SOLVING WITH A KNOWLEDGE-BASED EXPERT SYSTEM
Richard B. Hall Oct. 1985 28 p
(Contract N00014-83-C-0537)
(AD-A165398; PAR-85-108) Avail: NTIS HC A03/MF A01 CSCL 09/2

Previous research in the area of user/expert system interaction has shown that the quality of problem solving with a general expert system (ES) is associated with mental model, a user's conceptual understanding of the basic principle of an ES's problem solving process. The current paper describes an experiment with MYCIN, a medical knowledge-based expert system, that lends additional support to the link between problem solving quality and mental model. GRA

N86-26318# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
COCKPIT AUTOMATION REQUIREMENTS DERIVED FROM MISSION FUNCTIONS DATA
Bernadette Faulkner, R. Seifert, and K. D. Richter *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 7 p refs (For primary document see N86-26316 17-04)
Avail: NTIS HC A07/MF A01

N86-26319# Ferranti Defence Systems Ltd., Edinburgh (Scotland).
AUTOMATION AND PILOT INTERACTIONS IN NIGHT OR ALL-WEATHER TACTICAL OPERATIONS
W. H. McKinlay *In* AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations Oct. 1985 10 p (For primary document see N86-26316 17-04)
Avail: NTIS HC A07/MF A01

N86-26805# German Army Aviation School, Bueckeburg (West Germany).
OPERATIONAL EXPERIENCES WITH NIGHT VISION GOGGLES IN HELICOPTER LOW-LEVEL FLIGHT AT NIGHT
Hermann Haidn *In* AGARD Visual Protection and Enhancement Dec. 1985 8p refs (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

N86-26807# Naval Air Development Center, Warminster, Pa.
VISUAL AND SPECTRORADIOMETRIC PERFORMANCE CRITERIA FOR NIGHT VISION GOGGLES (NVG) COMPATIBLE AIRCRAFT INTERIOR LIGHTING
William A. Breitmaier and Ferdinand Reetz, III *In* AGARD Visual Protection and Enhancement Dec. 1985 11 p refs (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

N86-26813# Letterman Army Inst. of Research, San Francisco, Calif.
COMPUTER VISUAL SIMULATION OF CONTRAST SENSITIVITY DEFICITS INDUCED BY LASER AND CHEMICAL ANTIDOTE EXPOSURE
H. Zwick, D. Monroe, and L. Sherman *In* AGARD Visual Protection and Enhancement Dec. 1985 4 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

N86-26816# National Aerospace Medical Centre, Soesterberg (Netherlands).
DYNAMIC BEHAVIOUR OF SPHERICAL AND ASPHERICAL CONTACT LENSES EXPOSED TO +Gz-ACCELERATION FORCES
H. Punt, A. C. H. vandenHeuvel, H. H. vandenBiggelaar (Royal Netherlands Air Force, The Hague.), G. J. Hoekstra, and A. J. P. Rouwen (Militair Hospitaal Dr. A. Mathijsen, Utrecht (Netherlands).) *In* AGARD Visual Protection and Enhancement Dec. 1985 5 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

N86-26825# British Aerospace Public Ltd. Co., Lancashire (England). Cockpit Specialist Group.
HUMAN FACTORS: THE CINDERELLA DISCIPLINE IN COCKPIT INTERFACE DESIGN
K. W. Martin and J. Laycock (Royal Aircraft Establishment, Farnborough, England) *In* AGARD Visual Protection and Enhancement Dec. 1985 10 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

55 PLANETARY BIOLOGY

Includes exobiology; and extraterrestrial life.

N86-26844*# National Aeronautics and Space Administration, Washington, D.C.
SECOND SYMPOSIUM ON CHEMICAL EVOLUTION AND THE ORIGIN OF LIFE
Donald L. DeVincenzi, ed. and Patricia A. Dufour, ed. (George Washington Univ., Washington, D.C.) May 1986 128 p refs Symposium held at Moffett Field, Calif., 23-26 Jul. 1985
(Contract NASw-3165)
(NASA-CP-2425; NAS 1.55:2425) Avail: NTIS HC A07/MF A01 CSCL 06C

Recent findings by NASA Exobiology investigators are reported. Scientific papers are presented in the following areas: cosmic evolution of biogenic compounds, prebiotic evolution (planetary and molecular), early evolution of life (biological and geochemical), evolution of advanced life, solar system exploration, and the Search for Extraterrestrial Intelligence (SETI). For individual titles, see N86-26845 through N86-26913.

N86-26845*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ORGANIC CHEMISTRY OF MURCHISON METEORITE: CARBON ISOTOPIC FRACTIONATION **c90**
George U. Yuen (Arizona State Univ., Tempe), Neal E. Blair (North Carolina State Univ., Raleigh), David J. DesMarais, John R. Cronin (Arizona State Univ., Tempe), and Sherwood Chang *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 40 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

The carbon isotopic composition of individual organic compounds of meteoritic origin remains unknown, as most reported carbon isotopic ratios are for bulk carbon or solvent extractable fractions. The researchers managed to determine the carbon isotopic ratios for individual hydrocarbons and monocarboxylic acids isolated from a Murchison sample by a freeze-thaw-ultrasonication technique. The abundances of monocarboxylic acids and saturated hydrocarbons decreased with increasing carbon number and the acids are more abundant than the hydrocarbon with the same carbon number. For both classes of compounds, the C-13 to C-12 ratios decreased with increasing carbon number in a roughly parallel manner, and each carboxylic acid exhibits a higher isotopic number than the hydrocarbon containing the same number of carbon atoms. These trends are consistent with a kinetically controlled synthesis of higher homologues for lower ones. Author

N86-26846*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CHARACTERIZATION OF BIOGENIC ELEMENTS IN INTER-

PLANETARY DUST PARTICLES
T. E. Bunch *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 41 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

Those particles that were designated cometary are aggregates of amorphous materials including carbon, iron-magnesium silicates, sulfides, metal and trace amounts of unusual phases. Most aggregates are carbon-rich with major and minor element abundances similar to a fine grained matrix of carbonaceous chondrites. Several particles were analyzed by a laser microprobe. The negative ionic species identified to date include carbon clusters, protonated carbon clusters, CN-, HCN-, CNO-, PO2-, PO3-, S-, S2- asnd OH-. These species are similar to those observed in cometary spectra and they support the assumption that organic materials are present. The occurance of phosphate ions suggests the presence of apatite or whitlockite. Cometary particle characteristics may indicate that the component grains represent primitive unaltered dust whose overall properties are extremely similar to altered primitive dust in carbonaceous chondrites. Author

N86-26847*# Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.
BOUNDARY CONDITIONS FOR THE PALEOENVIRONMENT: CHEMICAL AND PHYSICAL PROCESSES IN DENSE INTERSTELLAR CLOUDS
William M. Irvine, F. Peter Schloerb, and Lucy M. Ziurys *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 42 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

The present research includes searches for important new interstellar constituents; observations relevant to differentiating between different models for the chemical processes that are important in the interstellar environment; and coordinated studies of the chemistry, physics, and dynamics of molecular clouds which are the sites or possible future sites of star formation. Recent research has included the detection and study of four new interstellar molecules; searches which have placed upper limits on the abundance of several other potential constituents of interstellar clouds; quantitative studies of comparative molecular abundances in different types of interstellar clouds; investigation of reaction pathways for astrochemistry from a comparison of theory and the observed abundance of related species such as isomers and isotopic variants; studies of possible tracers of energenic events related to star formation, including silicon and sulfur containing molecules; and mapping of physical, chemical, and dynamical properties over extended regions of nearby cold molecular clouds. Author

N86-26848*# Molecular Research Inst., Palo Alto, Calif.
INTERSTELLAR ISOMERS
Doug DeFrees, Dough McLean (IBM Research Lab., San Jose, Calif.), and Eric Herbst (Duke Univ., Durham, N. C.) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 43 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

Both observational and theoretical studies of molecular clouds are hindered by many difficulties. One way to partially circumvent the difficulties of characterizing the chemistry within these objects is to study the relative abundances of isomers which are synthesized from a common set of precursors. Unfortunately, only one such system has been confirmed, the HCN/HNC pair of isomers. While the basic outlines of its chemistry have been known for some years, there are still many aspects of the chemistry which are unclear. Another potential pair of isomers is HCO+/HOC+; HCO+ is an abundant instellar molecule and a tentative identification of HOC+ has been made in Sgr B2. This identification is being challenged, however, based on theoretical and laboratory evidence that HOC+ reacts with H2. Another potential pair of interstellar isomers is methyl cyanide (CH3CN, acetonitrile) and methyl isocyanide (CH3NC). The cyanide is well known, however the isocyanide has yet to be observed despite theoretical predictions that appreciable quantities should be present. Author

N86-26849*# Rensselaer Polytechnic Inst., Troy, N.Y.
PHOTOLYSIS PRODUCTS OF CO, NH3 AND H2O AND THEIR SIGNIFICANCE TO REACTIONS ON INTERSTELLAR GRAINS
James P. Ferris *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 44 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

With the increase in evidence that interstellar grains are the basic building blocks of comets and with the realization that comet collisions with the earth have probably occured at a much higher frequency than earlier assumed it may be presumed that interstellar dust chemistry played an important role in the early chemistry of the earth. As a part of the study of the photochemical processes taking place on interstellar grains the photolysis of mixtures of CO, NH3 and H2O was performed at 10 K, 77K and 298K. The reaction products were determined by GC/MS and HPLC analysis to be lactic acid, glycolic acid, hydroxyacetamide, urea, biuret, oxamic acid, oxamide, glyceric acid and glyceramide. Ethylene glycol and glycerol were also detected but is is not clear at present whether these are true photoproducts or contaminants. The mechanism of formation of these molecules are discussed as well as their possible significance to the origins of life. Author

N86-26850*# California Univ., Berkeley. Dept. of Astronomy.
OBSERVATIONAL EXOBIOLOGY
Jill Tarter *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 45 Prepared in cooperation with Search for Extraterrestrial Intelligence Inst., Los Altos, Calif. (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

The Earth's atmosphere absorbs partially or completely many ultraviolet, infrared and submillimeter wavelengths. Atmospheric seeing distorts small images, imposing a limit on the achievable angular resolution at optical and infrared wavelengths that is much poorer than the intrinsic capability of telescope optics. The atomic and molecular species of the atmosphere confuse or prevent the spectral studies of similar compounds outside of the terrestrial environment. Telescopes placed in orbit above the atmosphere avoid these problems and enjoy a unique view of the universe. There are many complex questions pertaining to the origin and evolution of the biogenic elements and compounds and the existence of terrestrial types of planets elsewhere that can be only tackled from orbiting facilities. The detailed nature of the spacecraft, platforms and instrumentation most likely to be launched by the United States and Europe in the near future in an attempt to determine what observational programs would be tractable and which areas of interest to exobiology required hardware capabilities beyond those currently envisioned are considered. Author

N86-26851*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE PRODUCTION OF TRACE GASES BY PHOTOCHEMISTRY AND LIGHTNING IN THE EARLY ATMOSPHERE **c46**
Joel S. Levine, Geoffrey M. Tennille, Kenneth M. Towe (Smithsonian Institution, Washington, D. C.), and Raj K. Khanna (Maryland Univ., College Park.) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 47 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

Recent atmospheric calculation suggest that the prebiological atmosphere was most probably composed of nitrogen, carbon dioxide, and water vapor, resulting from volatile outgassing, as opposed to the older view of a strongly reducing early atmosphere composed of methane, ammonia, and hydrogen. Photochemical calculations indicate that methane would have been readily destroyed via reaction with the hydroxyl radical produced from water vapor and that ammonia would have been readily lost via photolysis and rainout. The rapid loss of methane and ammonia, coupled with the absence of a significant source of these gases,

suggest that atmospheric methane and ammonia were very short lived, if they were present at all. An early atmosphere of N2, CO2, and H2O is stable and leads to the chemical production of a number of atmospheric species of biological significance, including oxygen, ozone, carbon monoxide, formaldehyde, and hydrogen cyanide. Using a photochemical model of the early atmosphere, the chemical productionof these species over a wide range of atmospheric parameters were investigated. These calculations indicate that early atmospheric levels of O3 were significantly below the levels needed to provide UV shielding. The fate of volcanically emitted sulfur species, e.g., sulfur dioxide and hydrogen sulfide, was investigated in the early atmosphere to assess their UV shielding properties. The photochemical calculations show that these species were of insufficient levels, due in part to their short photochemical lifetimes, to provide UV shielding. Author

N86-26852*# Cornell Univ., Ithaca, N.Y. Lab. for Planetary Studies.

THE ORGANIC AEROSOLS OF TITAN

B. N. Khare, C. Sagan, W. R. Thompson, E. T. Arakawa, F. Suits, T. A. Calcott, M. W. Williams, S. Shrader, H. Ogino, T. O. Willingham et al *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 48 Submitted for publication (For primary document see N86-26844 17-55)

Avail: NTIS HC A07/MF A01 CSCL 06C

A dark reddish organic solid, called tholin, is synthesized from simulated Titanian atmospheres by irradiation with high energy electrons in a plasma discharge. The visible reflection spectrum of this tholin is found to be similar to that of high altitude aerosols responsible for the albedo and reddish color of Titan. The real (n) and imaginary (k) parts of the complex refractive index of thin films of Titan prepared by continuous dc discharge through a 0.9 N2/0.1 CH4 gas mixture at 0.2 mb is determined from X-ray to microwave frequencies. Values of n (approx. 1.65) and k (approx, 0.004 to 0.08) in the visible are consistent with deductions made by groundbased and spaceborne observations of Titan. Many infrared absorption features are present in k(lambda), including the 4.6 micrometer nitrile band. Molecular analysis of the volatile components of this tholin was performed by sequential and nonsequential pyrolytic gas chromatography/mass spectrometry. More than one hundred organic compounds are released; tentative identifications include saturated and unsaturated aliphatic hydrocarbons, substituted polycylic aromatics, nitriles, amines, pyrroles, pyrazines, pyridines, pyrimidines, and the purine, adenine. In addition, acid hydrolysis produces a racemic mixture of biological and nonbiological amino acids. Many of these molecules are implicated in the origin of life on Earth, suggesting Titan as a contemporary laboratory environment for prebiological organic chemistry on a planetary scale. Author

N86-26853*# Harvard Univ., Cambridge, Mass.

THE D TO H RATIO ON TITAN AND THE PLANETS: IMPLICATIONS FOR ORIGIN AND EVOLUTION OF PLANETARY ATMOSPHERES

J. P. Pinto, J. I. Lunine (California Inst. of Tech., Pasadena), S.-J. Kim, and Y. L. Yung *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 49 (For primary document see N86-26844 17-55)

Avail: NTIS HC A07/MF A01 CSCL 06C

Measurements of deuterated methane show that Titan's atmosphere is enriched by at least several times in deuterium compared to the major planets. Potential causative factors for this enrichment are condensation to form tropospheric methane clouds, fractionation occuring over a hypothetical CH4-C2H2 ocean and between the ocean and the clathrate crust beneath, fractionation which occurred during the formation of Titan and fractionation occuring as a result of the evolution of Titan's atmosphere. The greater part of the observed fractionation is probably derived from the formation of Titan and the subsequent evolution of Titan atmosphere driven by photochemistry. The latter process is developed here for the first time. The D/H ratio in a planetary atmosphere is one readily available measure of the origin and evolution of the hydrogen bearing volatiles on the planet. Comparison between D/H ratio in the inner solar system and the outer solar system may pose important constraints on current theories. Author

N86-26854*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MEASUREMENTS OF PHYSICAL PROPERTIES OF MODEL TITAN ATMOSPHERES **c91**

Thomas W. Scattergood (State Univ. of New York, Stony Brook.), Sherwood Chang, Chris McKay, Bonnie OHara, and Glenn Carle *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 50 (For primary document see N86-26844 17-55)

Avail: NTIS HC A07/MF A01 CSCL 06C

One aspect of the study of Titan's atmosphere is the elucidation of the chemical and physical nature of the aerosols. In order to facilitate this, a program to produce laboratory synthesized model materials for Titan's aerosol and to study their chemical and physical properties is now in progress. Various processes, including electric discharge, photolysis by ultraviolet light, and irradiation by energetic particles, will be used to produce the materials. A first set of experiments where a nominal Titan mixture (97%N2, 3% CH4, 0.2% H2) was subjected to pulsed high temperature shocks yielded a reddish brown waxy solid. This material was subjected to pyrolysis/gas chromatography, a technique that has been proposed as a method for analysis of the Titan aerosols. Preliminary results show the material to consist of simple hydrocarbons but little else, at least up to temperatures of 600 C. Since the material was colored, compounds other than those mentioned above must be present. Author

N86-26855*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENTAL BASIS FOR A TITAN PROBE ORGANIC ANALYSIS **c91**

C. P. McKay, T. W. Scattergood (State Univ. of New York Stony Brook.), W. J. Borucki, J. F. Kasting, and S. L. Miller (California Univ., San Diego, La Jolla) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 52 (For primary document see N86-26844 17-55)

Avail: NTIS HC A07/MF A01 CSCL 06C

The recent Voyager flyby of Titan produced evidence for at least nine organic compounds in that atmosphere that are heavier than methane. Several models of Titan's atmosphere, as well as laboratory simulations, suggest the presence of organics considerably more complex that those observed. To ensure that the in situ measurements are definitive with respect to Titan's atmosphere, experiment concepts, and the related instrumentation, must be carefully developed specifically for such a mission. To this end, the possible composition of the environment to be analyzed must be bracketed and model samples must be provided for instrumentation development studies. Laboratory studies to define the optimum flight experiment and sampling strategy for a Titan entry probe are currently being conducted. Titan mixtures are being subjected to a variety of energy sources including high voltage electron from a DC discharge, high current electric shock, and laser detonation. Gaseous and solid products are produced which are then analyzed. Samples from these experiements are also provided to candidate flight experiments as models for instrument development studies. Preliminary results show that existing theoretical models for chemistry in Titan's atmosphere cannot adequetely explain the presence and abundance of all trace gases observed in these experiments. Author

N86-26856*# National Aeronautics and Space Administration, Washington, D.C.

A GAS CHROMATOGRAPH EXPERIMENT FOR A TITAN ENTRY PROBE

Glenn C. Carle, Daniel R. Kojiro, Bonnie J. OHara, Jose R. Valentin, Verne R.s W. Oberbeck, and Thomas W. Scattergood (State Univ.

of New York, Stony Brook) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 53 (For primary document see N86-26844 17-55)
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Development of a gas chromatographic technique for analysis of aerosols and volatile organics from a Titan probe is now in progress. Preliminary investigations of aerosol collectors have shown that an electrostatic device should be the most efficient for the particle sizes expected in Titan's atmosphere. Such a device particularly lends itself to development of a simple pyrolyzer which can be used to break down any collected organic conglomerate structures into volatile fragments. Those fragments can subsequently be analyzed by GC providing information about the original chemical structure of the aerosols. Studies show that as little as 1 to 5 micrograms of model aerosol can be successfully analyzed. High altitude atmospheric gas sampling will also be important on Titan due to the great depth of the atmosphere. Studies show that a GC analysis of model Titan atmospheres at pressures approximating this altitude can be made with a sensitivity of a few ten's of parts-per-billion for the trace gases of interest. Author

N86-26857*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MOLECULAR AND ELEMENTAL DUST ANALYZER (MEDA) FOR THE COMET RENDEZVOUS ASTEROID FLYBY MISSION
Bonnie J. OHara, Glenn C. Carle, and Benton C. Clark (Martin Marietta Aerospace, Denver, Colo.) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 54 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

Comets are some to the most primitive bodies in the solar system and therefore should contain elemental, chemical, and isotopic records of the early history of the solar system. An opportunity to perform in situ analyses of a comet nucleus exists with the Comet Rendezvous Asteroid Flyby (CRAF) mission. An integrated gas chromatograph/X-ray fluorescence instrument (MEDA), being proposed for inclusion onboard the CRAF spacecraft, will measure the molecular and elemental constituents of collected dust grains and ices. The gas chromatograph, employing helium ionization detectors and three columns designed to separate light gases, polar gases, and hydrocarbons will measure the volatile compounds of the biogenic elements thermally released from collected dust grains. The sensitivity of the GC for compounds of interest is at the picogram level. X-ray fluorescence utilized cryogenically cooled Si(Li) solid state detectors of nominal 150 eV resolution at 5.9 keV. Based on laboratory work with carbonaceous meteorites, both the GC and XRF can perform meaningful analyses with a few micrograms of collected comet dust. Author

N86-26858*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INVESTIGATION OF POROUS POLYMER GAS CHROMATOGRAPHIC PACKINGS FOR ATMOSPHERIC ANALYSIS OF EXTRATERRESTRIAL BODIES
Glenn E. Pollock *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 55 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

Measurement of the permanent gases in the atmospheres of mission targets is a major objective. A 16 meter long Porapak N column was used on the Venus probe and required a rather high carrier gas flow rate. The researchers have, therefore, surveyed commercial porous polymer types which had some ability to resolve nitrogen, oxygen, argon and carbon monoxide gases. Porapaks N and Q appeared superior to most. Batch to batch variation, however, was quite wide, so the researchers learned how to synthesize porous polymer and investigated some of the factors affecting the separations. A polymer was synthesized which was superior to all commercial products and allowed at least a 50% reduction in length and flow rate of carrier gas. Similar studies were made concerning the separation of hydrocarbons and new porous polymers have been synthesized which represent significant improvements in time of analysis, column, and carrier gas flow rate. Author

N86-26859*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MINIATURE METASTABLE IONIZATION DETECTORS FOR EXOBIOLOGY FLIGHT EXPERIMENTS
Fritz H. Woeller *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 56 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

The Metastable Ionization Detector (MID) is three orders of magnitude more sensitive than the thermal conductivity detectors used on previous flight instruments. The miniature MID provides scientists with a much smaller and highly sensitive detector for flight gas chromatographs. A miniature MID featuring an unconventional triaxial electrode configuration was developed and used routinely in the laboratory. Although much smaller and lighter than the commercial MID, its performance characteristics parallel those of the traditional design. The detector is compatible with the modulated voltage circuitry, also developed here, and thus can perform over an expanded response range of more than 7 orders magnitude. A micro volume version of a miniature MID, with an internal volume of less than 8 microliter, was recently designed is now being tested. The micro volume MID uses carrier gas flow rates of approx. 2cc/min thus eliminating the need for makeup gas when capillary columns are used. Author

N86-26860*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MULTIPLEX GAS CHROMATOGRAPHY: A NOVEL ANALYTICAL TECHNIQUE FOR FUTURE PLANETARY STUDIES
Jose R. Valentin, Glenn C. Carle, and John B. Phillips (University of Southern Illinois, Carbondale) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 57 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

Determination of molecular species comprised of the biogenic elements in the atmospheres of planets and moons of the solar system is one the foremost requirements of the exobiologist studying chemical evolution and the origin of life. Multiplex chromatography is a technique where many samples are pseudo-randomly introduced to the chromatograph without regard to elution of preceding components. The resulting data are then reduced using mathematical techniques such as cross correlation or Fourier Transforms. To demonstrate the utility of this technique for future solar system exploration, chemical modulators were developed. Several advantages were realized from this technique in combination with these modulators: improvement in detection limits of several orders of magnitude, improvement in the analysis of complex mixtures by selectively modulating some of the components present in the sample, increase in the number of analyses that can be conducted in a given period of time, and reduction in the amount of expendables needed to run an analysis. In order to apply this technique in a real application, methane in ambient air was monitored continuously over a period of one week. By using ambient air as its own carrier all expendables beyond power were eliminated. Author

N86-26861*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ION MOBILITY DRIFT SPECTROMETER (IMDS) AS A FLIGHT ANALYTICAL INSTRUMENT TECHNIQUE
Daniel R. Kojiro and Glenn C. Carle *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 58 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

A detailed knowledge of the history and abundances of the biogenic elements and their compounds throughout the solar system can provide the exobiologists with a basis for understanding

the conditions necessary for chemical evolution and the origin of life. The Ion Mobility Drift Spectrometer is an ion molecule reactor coupled with an ion drift spectrometer. Sample molecules are ionized to form product ions in the reactant region. An electric field moves the ions through a drift region against the flow of a drift gas where they are separated according to their size and structure producing an ion mobility spectrum. These spectra provide the IMDS with virtually universal sample identification capability. To conform to the rigid limits of weight, volume and consumables placed on flight instrumentation, several aspects of the IMDS must be studied and redesigned for flight use. In addition to miniaturization of the instrument, a reduction in the high flow rates used for the drift gas is an obvious necessary consideration. The effect of drastically reduced drift flow rates on IMDS spectra was investigated by lowering flow rates from 500ml/min to 50ml/min. Changes in peak shape, drift time and total spectra were studied at each flow rate. Author

N86-26862*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NEW TECHNIQUES FOR THE DETECTION AND CAPTURE OF MICROMETEOROIDS **c91**

John H. Wolfe (San Jose State Univ., Calif.), Theodore E. Bunch, and Glenn C. Carle *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 59 (For primary document see N86-26844 17-55)

Avail: NTIS HC A07/MF A01 CSCL 06C

In order to understand the origin and distribution of the biogenic elements and their compounds in the solar system, it will be necessary to study material from many classes of objects. Chemical, elemental, and isotopic measurements of returned samples of comets, asteroids, and possibly extra-solar system dust clouds would provide information on a particularly important class: the primitive objects. Extraterrestrial micron-sized particles in the vicinity of earth are one source of such materials that might otherwise be inaccessible. The Space Station appears to be an eminently suitable platform from which to collect and detect these various particles. The primary challenge, however, is to collect intact, uncontaminated particles which will be encounted at tens of kilometers per seconds. A concept for a micrometeoroid detector that could be deployed at a Space Station has been developed which uses a large area detector plate implanted with acoustic transducers. When an impact event occurs, the resulting signal is subjected to spectral analysis providing positive detection, momentum information, and angle of incidence. The primary advantage of this detector is the large area which increases the probability of measuring events. Author

N86-26863*# California Univ., San Diego, La Jolla. Dept. of Chemistry.

ENERGY YIELDS IN THE PREBIOTIC SYNTHESIS OF HYDROGEN CYANIDE AND FORMALDEHYDE

Roscoe Stribling and STanley L. Miller *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 61 (For primary document see N86-26844 17-55)

Avail: NTIS HC A07/MF A01 CSCL 06C

Prebiotic experiments are usually reported in terms of carbon yields, i.e., the yield of product based on the total carbon in the system. These experiments usually involve a large input of energy and are designed to maximize the yields of product. However, large inputs of energy result in multiple activation of the reactants and products. A more realistic prebiotic experiment is to remove the products of the activation step so they are not exposed a second time to the energy source. This is equivalent to transporting the products synthesized in the primitive atmosphere to the ocean, and thereby protecting them from destruction by atmospheric energy sources. Experiments of this type, using lower inputs of energy, give energy yields (moles of products/joule) which can be used to estimate the relative importance of the different energy sources on the primitive earth. Simulated prebiotic atmospheres containing either CH4, CO or CO2 with N2, H2O and variable amounts of H2 were subjected to a high frequency Tesla coil. Samples of the aqueous phase were taken at various time intervals from 1 hr to 7 days, and the energy yields were obtained by extrapolation to zero time. The samples were analyzed for HCN with the cyanide electrode and for H2CO by chromotropic acid. The spark energy was estimated by calorimetry. The temperature rise in an insulated discharge flask was compared with the temperature rise from a resistance heater in the same flask. These results will be compared with calculated production rates of HCN and H2CO from lightning and a number of photochemical processes on the primitive Earth. Author

N86-26864*# Maryland Univ., College Park. Lab. of Chemical Evolution.

SYNTHESIS AND ANALYSIS IN STUDIES OF CHEMICAL EVOLUTION

Cyril Ponnamperuma, Mitchell K. Hobish, Kensei Kobayashi, Lu-Lin Hua, and Nalinie Senaratne *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 62 (For primary document see N86-26844 17-55)

Avail: NTIS HC A07/MF A01 CSCL 06C

Studies of the various processes that may have given rise to life on the Earth have demonstrated the appropriateness of an approach that makes use of analysis and synthesis. Analysis of extraterrestrial samples in the form of meteorites has demonstrated the presence of several precursors of biomolecules, most notably a full suite of nucleic acid bases and nucleotides of biological significance. These species were determined after exhaustive extraction of the sample and subsequent analysis using HPLC, GC, MS, and GC-MS. Procedural blanks indicate that these molecules are likely not the result of contamination during the extraction and analysis process. Similar species were found as products of spark discharge experiments in atmospheres thought to mimic primitive Earth conditions. These results indicate that the basic chemistry underlying these syntheses is common, and that life may not be unique to the Earth. Studies underway in the laboratory make use of proton nuclear magnetic resonance spectroscopy as a probe to assess associations between selected amino acids and any of several nucleotides comprising their genetic code and genetic anticode sequences. These studies demonstrate a clear selectivity by the anticode sequences, thus confirming the hydrophobicity studies performed by Lacey et al. These studies further support the contention that life is likely a natural result of the physics and chemistry of the universe. Author

N86-26865*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ISOTOPIC CHARACTERISATION OF PREBIOTIC SYNTHESIS OF ORGANIC MATERIAL

John F. Kerridge (California Univ., Los Angeles.) and Sherwood Chang *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 63 (For primary document see N86-26844 17-55)

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Many primitive meteorites contain an insoluble organic material, much like terrestrial kerogen, whose mode of origin is currently unknown. When subjected to stepwise decomposition, this material, unlike its terrestrial counterpart, reveals characteristic release patterns for the stable isotopes of carbon, hydrogen and nitrogen as a function of fractional release of each element. The purpose of this study is to try to match those release patterns using organic matter synthesised in the laboratory under controlled conditions. If successful, such a study would shed light on the origin of kerogen-like organic matter in the early solar system and, by extension, on prebiotic organic synthesis in general. The range of possible syntheses, starting materials and reaction conditions to be investigated is considerable. Samples analysed to date include: a heavy oil produced by Fischer-Tropsch-type catalysis of CO + H2; a solid residue generated by a plasma discharge in CO + H2 + N2; a solid deposited on the electrodes of a Miller-Urey synthesis operating on CH4 + H2O + N2; and a solid residue formed by polymerization of light hydrocarbons procured by a Miller-Urey discharge acting on CH4. Significant structure is observed in the

release patterns for the carbon and hydrogen isotopes from the synthetic samples, though there is little evidence for isotopic fractionation during the analysis itself. Author

N86-26866*# Massachusetts Inst. of Tech., Cambridge.
ORIGIN OF LIFE AND IRON-RICH CLAYS
Hyman H. Hartman *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 pen1] 64 (For primary document see N86-26844 17-55)
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The premise that life began with self-replicating iron-rich clays is explored. In association with these clays and UV light, polar organic molecules, such as oxalic acid, were synthesized. The carbonaceous chondrites have both iron-rich clays and organic molecules. It is convenient to classify meteoritic organic matter into 3 categories: insoluble polymer, hydrocarbons and polar organics (soluble in water). Recent work on the delta D, delta N-15 and delta C-13 has made it clear that these three fractions have been made by three different mechanisms. A significant fraction of the insoluble polymer has a delta-D which suggests that it was made in an interstellar medium. The hydrocarbons seem to have been made on a parent body by a Fischer-Tropsch mechanism. The polar organics were probably synthesized in a mixture of carbonate (NH4)2CO3, Fe(++) ion and liquid water by radiolysis. In a set of experiments the radiolysis of (NH4)2CO3 in the presence and absence of Fe(++) ion has been examined. The synthesis of glycine in the presence of Fe(++) ion is 3-4 times that in the absence of ferrous ion. The effects of the addition of hydrocarbons to this mixture are explored. Iron-rich clays at low temperature and pressure are synthesized. So far the results are not sufficiently crystalline to look for replication. It should be noted that organic chelating agents such as oxalic acid do increase the crystallinity of the clays but not sufficiently. The hydrothermal synthesis of iron-rich clays is being examined.
Author

N86-26867*# San Jose State Univ., Calif.
CLAY ENERGETICS IN CHEMICAL EVOLUTION
Lelia M. Coyne *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 65 (For primary document see N86-26844 17-55)
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Clays have been implicated in the origin of terrestrial life since the 1950's. Originally they were considered agents which aid in selecting, concentrating and promoting oligomerization of the organic monomeric substituents of cellular life forms. However, more recently, it has been suggested that minerals, with particular emphasis on clays, may have played a yet more fundamental role. It has been suggested that clays are prototypic life forms in themselves and that they served as a template which directed the self-assembly of cellular life. If the clay-life theory is to have other than conceptual credibility, clays must be shown by experiment to execute the operations of cellular life, not only individually, but also in a sufficiently concerted manner as to produce some semblance of the functional attributes of living cells. Current studies are focussed on the ability of clays to absorb, store and transfer energy under plausible prebiotic conditions and to use this energy to drive chemistry of prebiotic relevance. Conclusions of the work are applicable to the role of clays either as substrates for organic chemistry, or in fueling their own life-mimetic processes. Author

N86-26868*# Polytechnic Inst. of New York, Brooklyn.
FURTHER WORK ON SODIUM MONTMORILLONITE AS CATALYST FOR THE POLYMERIZATION OF ACTIVATED AMINO ACIDS
Frederick R. Eirich and Mella Paecht-Horowitz (Hebrew Univ. of Jerusalem, Rehovot (Israel).) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 66 (For primary document see N86-26844 17-55)
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When the polycondensation of amino acid acylates was catalyzed with Na-montmorillonite, the polypeptides were consistently found to exhibit a distribution of discrete molecular weights, for as yet undiscovered reasons. One possible explanation was connected to the stepwise mode of monomer addition. New experiments have eliminated this possibility, so that there is the general assumption that this discreteness is the result of a preference of shorter oligomers to add to others of the same length, a feature that could be attributed to some structure of the platelet aggregates of the montmorillonite. The production of optical stereoisomers is anticipated when D,L-amino acids are polymerized on montmorillonite. Having used an optically active surface, the essence of the results lies not only in the occurrence of optically active oligomers and polymers, but also in the fact that the latter exhibit the same molecular weight characteristics as the D,L-polymers. Preparatory to work contemplated on a parallel synthesis of amino acid and nucleotide oligomers, studies were continued on the co-adsorption of amino acids, nucleotides, and amino acid-nucleotides on montmorillonite. Author

N86-26869*# San Francisco State Univ., Calif. Dept. of Chemistry.
ADSORPTION AND CONDENSATION OF AMINO ACIDS AND NUCLEOTIDES WITH SOLUBLE MINERAL SALTS
James Orenberg and Noam Lahav (Hebrew Univ. of Jerusalem, Rehovot (Israel).) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 67 (For primary document see N86-26844 17-55)
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The directed synthesis of biopolymers in an abiotic environment is presumably a cyclic sequence of steps which may be realized in a fluctuating environment such as a prebiotic pond undergoing wetting-drying cycles. Soluble mineral salts have been proposed as an essential component of this fluctuating environment. The following sequence may be considered as a most primitive mechanism of information transfer in a fluctuating environment: (1) adsorption of a biomolecule onto a soluable mineral salt surface to act as an adsorbed template; (2) specific adsorption of biomonomers onto the adsorbed template; (3) condensation of the adsorbed biomonomers; and (4) desorption of the elongated oligomer. In this investigation, the salts selected for study were CaSO4.2H2O(gypsum), SrSO4, and several other metal sulfates and chlorides. Adsorption of the monomeric species, gly, 5'AMP 5'GMP, and 5'CMP was investigated. The adsorbed template biopolymers used were Poly-A, Poly-G, Poly-C, and Poly-U. The results of studies involving these experimental participants, the first two steps of the proposed primitive information transfer mechanism, and condensation of amino acids to form oligomers in a fluctuating environment are to be reported. Author

N86-26870*# Harvard Univ., Cambridge, Mass.
PALEOSOLS AND THE CHEMICAL EVOLUTION OF THE ATMOSPHERE
H. D. Holland, E. A. Zbinden, and J. P. Pinto *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evoltuion of Life May 1986 p 68 (For primary document see N86-26844 17-55)
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The chemistry and mineralogy of soils reflects the chemistry of the atmosphere below which they develop. Today the presence of a cover of land plants can obscure the signature of a highly oxidizing atmosphere. Prior to the advent of higher land plants ca. 400 m.y. ago the obscuring effect of a biological interface should have been minor. It can be shown that under such conditions the behavior of ferrous iron during weathering depends on the relationship between the ratio of the net concentration of oxidants to the concentration of acids in rainwater, and on the ratio of the oxygen demand to the acid demand for complete weathering of the parent rock. An analysis of the behavior of iron in some 15 paleosols between 1.0 and 2.9 b.y. in age showed some time ago that iron was retained, or largely retained, in paleosols developed on rocks with a low ratio of oxidant demand to acid demand (R value) and was lost from paleosols with a high R value. The results indicate that between 1.1 and 2.9 b.y.b.p. the ratio of the net concentration of oxidants to CO2 in rainwater was less than ca. 1/600 of the present-day value. Work during the

past year has sought to extend the data base for paleosols and to define more precisely the relationships between the composition of paleosols and the chemistry of the atmosphere below which they developed. Author

N86-26871*# Santa Clara Univ., Calif. Dept. of Chemistry.
COOPERATION OF CATALYSTS AND TEMPLATES
David H. White, Anastassia Kanavarioti, CArle W. Nibley, and John W. Macklin (Washington Univ., Seattle.) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 69 (For primary document see N86-26844 17-55)
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In order to understand how self-reproducing molecules could have originated on the primitive Earth or extraterrestrial bodies, it would be useful to find laboratory models of simple molecules which are able to carry out processes of catalysis and templating. Furthermore, it may be anticipated that systems in which several components are acting cooperatively to catalyze each other's synthesis will have different behavior with respect to natural selection than those of purely replicating systems. As the major focus of this work, laboratory models are devised to study the influence of short peptide catalysts on template reactions which produce oligonucleotides or additional peptides. Such catalysts could have been the earliest protoenzymes of selective advantage produced by replicating oligonucleotides. Since this is a complex problem, simpler systems are also studied which embody only one aspect at a time, such as peptide formation with and without a template, peptide catalysis of nontemplated peptide synthesis, and model reactions for replication of the type pioneered by Orgel. Author

N86-26872*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MOLECULAR MICROENVIRONMENTS: SOLVENT INTERACTIONS WITH NUCLEIC ACID BASES AND IONS
R. D. MacElroy and A. Pohorille (California Univ., Berkeley.) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 70 (For primary document see N86-26844 17-55)
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The possibility of reconstructing plausible sequences of events in prebiotic molecular evolution is limited by the lack of fossil remains. However, with hindsight, one goal of molecular evolution was obvious: the development of molecular systems that became constituents of living systems. By understanding the interactions among molecules that are likely to have been present in the prebiotic environment, and that could have served as components in protobiotic molecular systems, plausible evolutionary sequences can be suggested. When stable aggregations of molecules form, a net decrease in free energy is observed in the system. Such changes occur when solvent molecules interact among themselves, as well as when they interact with organic species. A significant decrease in free energy, in systems of solvent and organic molecules, is due to entropy changes in the solvent. Entropy-driven interactions played a major role in the organization of prebiotic systems, and understanding the energetics of them is essential to understanding molecular evolution. Author

N86-26873*# Alabama Univ., Birmingham. Dept. of Biochemistry.
INTRAMOLECULAR INTERACTIONS IN AMINOACYL NUCLEOTIDES: IMPLICATIONS REGARDING THE ORIGIN OF GENETIC CODING AND PROTEIN SYNTHESIS
J. C. Lacey, Jr., D. W. Mullins, Jr., C. L. Watkins, and L. M. Hall *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 71 (For primary document see N86-26844 17-55)
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Cellular organisms store information as sequences of nucleotides in double stranded DNA. This information is useless unless it can be converted into the active molecular species, protein. This is done in contemporary creatures first by transcription of one strand to give a complementary strand of mRNA. The sequence of nucleotides is then translated into a specific sequence of amino acids in a protein. Translation is made possible by a genetic coding system in which a sequence of three nucleotides codes for a specific amino acid. The origin and evolution of any chemical system can be understood through elucidation of the properties of the chemical entities which make up the system. There is an underlying logic to the coding system revealed by a correlation of the hydrophobicities of amino acids and their anticodonic nucleotides (i.e., the complement of the codon). Its importance lies in the fact that every amino acid going into protein synthesis must first be activated. This is universally accomplished with ATP. Past studies have concentrated on the chemistry of the adenylates, but more recently we have found, through the use of NMR, that we can observe intramolecular interactions even at low concentrations, between amino acid side chains and nucleotide base rings in these adenylates. The use of this type of compound thus affords a novel way of elucidating the manner in which amino acids and nucleotides interact with each other. In aqueous solution, when a hydrophobic amino acid is attached to the most hydrophobic nucleotide, AMP, a hydrophobic interaction takes place between the amino acid side chain and the adenine ring. The studies to be reported concern these hydrophobic interactions. Author

N86-26874*# Salk Institute for Biological Studies, San Diego, Calif.
MOLECULAR REPLICATION
Leslie E. Orgel *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 72 (For primary document see N86-26844 17-55)
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The object of our research program is to understand how polynucleotide replication originated on the primitive Earth. This is a central issue in studies of the origins of life, since a process similar to modern DNA and RNA synthesis is likely to have formed the basis for the most primitive system of genetic information transfer. The major conclusion of studies so far is that a preformed polynucleotide template under many different experimental conditions will facilitate the synthesis of a new oligonucleotide with a sequence complementary to that of the template. It has been shown, for example, that poly(C) facilitates the synthesis of long oligo(G)s and that the short template CCGCC facilities the synthesis of its complement GGCGG. Very recently we have shown that template-directed synthesis is not limited to the standard oligonucleotide substrates. Nucleic acid-like molecules with a pyrophosphate group replacing the phosphate of the standard nucleic acid backbone are readily synthesized from deoxynucleotide 3'-5'-diphosphates on appropriate templates. Author

N86-26875*# Cornell Univ., Ithaca, N.Y. Dept. of Chemistry.
STEREOSELECTIVE AMINOACYLATION OF RNA
D. A. Usher, M. C. Needels, and T. Brenner *In* NASA, Washington Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 73 (For primary document see N86-26844 17-55)
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Prebiotic chemistry is faced with a major problem: how could a controlled and selective reaction occur, when there is present in the same solution a large number of alternative possible coreactants? This problem is solved in the modern cell by the presence of enzymes, which are not only highly efficient and controllable catalysts, but which also can impose on their substrates a precise structural requirement. However, enzymes are the result of billions of years of evolution, and we cannot invoke them as prebiotic catalysts. One approach to solving this problem in the prebiotic context is to make use of template-directed reactions. These reactions increase the number of structural requirements that must be simultaneously present in a molecule for it to be able to react, and thereby increase the selectivity of the reaction. They also can give a large increase in the rate of a reaction, if the template constrains two potential coreactants to lie close together. A third benefit is that information that is present in the template molecule can be passed on to the product molecules. If

the earliest organisms were based on proteins and nucleic acids, then the investigation of peptide synthesis on an oligonucleotide template is highly relevant to the study of the origin of life. Author

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MODELS OF GLYCOLYSIS: GLYCERALDEHYDE AS A SOURCE OF ENERGY AND MONOMERS FOR PREBIOTIC CONDENSATION REACTIONS

Arthur L. Weber *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 74 (For primary document see N86-26844 17-55)

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All organisms require energy in a chemical form for maintenance and growth. In contemporary life this chemical energy is obtained by the synthesis of the phosphoanhydride bonds of ATP. Among the biological processes that yield ATP, fermentation is generally considered primitive, because it operates under anaerobic conditions by substrate-level phosphorylation which does not require compartmentation by membranes. Fermentation by the glycolytic pathway, which is found in almost every living cell, is an especially attractive energy source for primitive life. Glycolysis not only produces useful chemical energy (ATP), but intermediates of this pathway are also involved in amino acid synthesis and photosynthetic carbon-fixation. It is believed that energy and substrates needed for the origin of life were provided by nonenzymatic chemical reactions that resemble the enzyme-mediated reactions of glycolysis. These nonenzymatic reactions would have provided a starting point for the evolutionary development of glycolysis. Author

N86-26877*# Roswell Park Memorial Inst., Buffalo, N. Y. Unit of Theoretical Biology.

A COMPARATIVE STUDY OF PREBIOTIC AND PRESENT DAY TRANSLATIONAL MODELS

R. Rein, G. Raghunathan, J. McDonald, M. Shibata, and S. Srinivasan *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evoilution of Life May 1986 p 75 (For primary document see N86-26844 17-55)

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It is generally recognized that the understanding of the molecular basis of primitive translation is a fundamental step in developing a theory of the origin of life. However, even in modern molecular biology, the mechanism for the decoding of messenger RNA triplet codons into an amino acid sequence of a protein on the ribosome is understood incompletely. Most of the proposed models for prebiotic translation lack, not only experimental support, but also a careful theoretical scrutiny of their compatibility with well understood stereochemical and energetic principles of nucleic acid structure, molecular recognition principles, and the chemistry of peptide bond formation. Present studies are concerned with comparative structural modelling and mechanistic simulation of the decoding apparatus ranging from those proposed for prebiotic conditions to the ones involved in modern biology. Any primitive decoding machinery based on nucleic acids and proteins, and most likely the modern day system, has to satisfy certain geometrical constraints. The charged amino acyl and the peptidyl termini of successive adaptors have to be adjacent in space in order to satisfy the stereochemical requirements for amide bond formation. Simultaneously, the same adaptors have to recognize successive codons on the messenger. This translational complex has to be realized by components that obey nucleic acid conformational principles, stabilities, and specificities. This generalized condition greatly restricts the number of acceptable adaptor structures. Author

N86-26878*# Miami Univ., Coral Gables, Fla. Inst. for MOlecular and Cellular Evolution.

PROTOBIOLOGICAL INFORMATION, BIDIRECTIONAL RECOGNITION AND REVERSE TRANSLATION

Sidney W. Fox, Tadayoshi Nakashima, Aleksander Przybylski, and Graham Vaughan *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 76 (For primary document see N86-26844 17-55)

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Emergence of protobiological information has been suggested by experiments in which heated mixtures of alpha-amino acids order themselves into a self limited array of thermal proteins. The polymers display selective catalytic, hormonal, and other activities. Interactions of varied cationic thermal proteins with polynucleotides indicate selective recognition in both directions. Reverse translation is partly a missing link in the molecular evolution flowsheet. The self ordering of amino acids serves conceptually as a deterministic evolutionary precursor of the modern coding mechanism. The possibility for the evolution of information at an early nontemplated protein stage is supported by findings of electrical signals from proteinoid microspheres prepared with no DNA/RNA in their history. The deposition of thermal copolyamino acids on lipid membranes in the Mueller-Rudin apparatus has here been found to produce electrical behavior like that evoked by bacterial EIM polypeptide. A new procedure is to make a film of membrane on the electrode; the results provide maximal repeatability. The principle of nonrandom biomacromolecular specificity identified by these studies in molecular evolution have been extrapolated to principles of evolution of advanced organisms. Author

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PHOTOCHEMICAL REACTIONS OF VARIOUS MODEL PROTOCELL SYSTEMS

Clair E. Folsome *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 77 (For primary document see N86-26844 17-55)

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Models for the emergence of cellular life on the primitive Earth, and for physical environments of that era have been studied that embody these assumptions: (1) pregenetic cellular forms were phase-bounded systems primarily photosynthetic in nature, and (2) the early Earth environment was anoxic (lacking appreciable amounts of free hydrogen). It was found that organic structures can also be formed under anoxic conditions (N_2, $CO_3^=$, H_2O) by protracted longwavelength UV radiation. Apparently these structures form initially as organic layers upon $CaCO_3$ crystalloids. The question remains as to whether the UV photosynthetic ability of such phase bounded structures is a curiosity, or a general property of phase bounded systems which is of direct interest to the emergence of cellular life. The question of the requirement and sailient features of a phase boundary for UV photosynthetic abilities was addressed by searching for similar general physical properties which might be manifest in a variety of other simple protocell-like structures. Since it has been shown that laboratory protocell models can effect the UV photosynthesis of low molecular weight compounds, this reaction is being used as an assay to survey other types of structures for similar UV photosynthetic reactions. Various kinds of structures surveyed are: (1) proteinoids; (2) liposomes; (3) reconstituted cell membrane spheroids; (4) coacervates; and (5) model protocells formed under anoxic conditions. M.G.

N86-26880*# Houston Univ., Tex.

THE PRINCIPLE OF COOPERATION AND LIFE'S ORIGIN AND EVOLUTION

J. Oro, Gil Armangue, and Arnulfo Mar *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 78 (For primary document see N86-26844 17-55)

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In simple terms a living entity is a negentropic system that replicates, mutates and evolves. A number of suggestions have been made, such as directed panspermia, atmospheric photosynthesis, genetic overtaking from inorganic processes, etc., as alternative models to the accepted Oparin-Haldane-Urey model of the origin of life on Earth. This has probably occurred because in spite of tremendous advances in the prebiotic synthesis of biochemical compounds, the fundamental problem of the appearance of the first life--a primordial replicating cell-ancestral to all other forms of extant life, has remained elusive. This is indeed a

reflection on the different fundamental nature of the problem involved. Regardless of which were the fundamental processes which occurred on the primitive Earth, it has to end up with the fundamental characteristics of an ancestral protocell. The problem of the emergence of the first ancestral cell was one of synergistic macromolecular cooperation, as it has been discussed by authors recently (COSPAR XXV Plenary Meeting). An analogous situation must have occurred at the time of the appearance of the first eucaryotic organism. Procaryotic life appeared probably during the first 600 million years of Earth history when the Earth was sufficiently cool and continually bombarded (in the late accretion period) by comets and minor bodies of the solar system, when the sea had not yet acquired its present form. Author

N86-26881*# Massachusetts Inst. of Tech., Cambridge. Dept. of Biology.

BASE PAIRING AND BASE MIS-PAIRING IN NUCLEIC ACIDS

Andrew H.-J. Wang and Alexander Rich *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 78 (For primary document see N86-26844 17-55)

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In recent years we have learned that DNA is conformationally active. It can exist in a number of different stable conformations including both right-handed and left-handed forms. Using single crystal X-ray diffraction analysis we are able to discover not only additional conformations of the nucleic acids but also different types of hydrogen bonded base-base interactions. Although Watson-Crick base pairings are the predominant type of interaction in double helical DNA, they are not the only types. Recently, we have been able to examine mismatching of guanine-thymine base pairs in left-handed Z-DNA at atomic resolution (1A). A minimum amount of distortion of the sugar phosphate backbone is found in the G x T pairing in which the bases are held together by two hydrogen bonds in the wobble pairing interaction. Because of the high resolution of the analysis we can visualize water molecules which fill in to accommodate the other hydrogen bonding positions in the bases which are not used in the base-base interactions. Studies on other DNA oligomers have revealed that other types of non-Watson-Crick hydrogen bonding interactions can occur. In the structure of a DNA octamer with the sequence d(GCG-TACGC) complexed to an antibiotic triostin A, it was found that the two central AT base pairs are held together by Hoogsteen rather than Watson-Crick base pairs. Similarly, the G x C base pairs at the ends are also Hoogsteen rather than Watson-Crick pairing. Hoogsteen base pairs make a modified helix which is distinct from the Watson-Crick double helix. Author

N86-26882*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CARBON EXCHANGE BETWEEN THE MANTLE AND THE CRUST AND ITS EFFECT UPON THE ATMOSPHERE: TODAY COMPARED TO ARCHEAN TIME

David DesMarais *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 81 (For primary document see N86-26844 17-55)

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Paleobiologists now recognize that the Earth's biosphere has been profoundly affected by geologic processes. One very important process is the dissipation of heat which has been generated by radioactivity and/or stored within the Earth. Heat flow is responsible for crustal movements and therefore it is the principal architect for constructing the environments (e.g. shallow marine, continental, etc.) wherein life developed and flourished. Heat flow has also influenced the movements of volatile elements (e.g. C, N, H, S, rare gases, etc.) both within the Earth's crust and between the crust and mantle. The inventory of these elements in the Earth's crust is important, not just because some of them constitute the building blocks of organic matter, but also because they influence the biosphere's climate. The purpose of this work is to evaluate how the decline of heat flow over the course of the Earth's history has influenced the carbon inventory in the Earth's crust. Such an evaluation must first consider whether the rate at which carbon is presently being exchanged between the mantle and crust is sufficient to play an important role in controlling the crustal inventory. Secondly, this exchange of carbon must be reevaluated in the context of the Precambrian Earth's environment. One very important consideration is that the upper mantle was perhaps 300 C hotter 3 b.y. ago than it is today. Author

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EARTH'S EARLY ATMOSPHERE AS SEEN FROM CARBON AND NITROGEN ISOTOPIC ANALYSIS OF ARCHEAN SEDIMENTS

Everett K. Gibson, Jr., L. P. Carr, I. Gilmour (Open Univ., Milton, England), and C. T. Pillinger *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 82 (For primary document see N86-26844 17-55)

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The origin and evolution of the Earth's early atmosphere has long been a topic of great interest but determination of actual compositions over geologic time is a difficult problem. However, recent systematic studies of stromatolite deposits (Precambrian Paleobiology Research Group) has extended our knowledge of Archean ecosystems. It has been shown that many stromatolite deposits have undergone negligible alteration since their time of formation. The discovery of primary fluid inclusions within unaltered 3.5 b.y. old Archiean sediments and the observation that the 3.3 b.y. old Barberton cherts have remained closed to argon loss and have not been subjected to thermal metamorphism suggests that an opportunity exists for the direct measurement of the volatile constituents present at their time of formation. Of primary interest to this study was the possibility that the stromatoiites and other Archean sediments might retain a vestige of the atmosphere and thus afford an indication of the variations in carbon dioxide and nitrogen isotopic compositions with time. A suite of essentially unaltered Archean stromatolites and the cherts of different ages and geologic sites have been analyzed for their trapped carbon dioxide and nitrogen compositions by the stepped combustion extraction tech nique utilizing static mass spectrometers for the isotope measurements. Author

N86-26884*# California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.

USE OF LABORATORY SIMULATED PYROLYSIS IN TRACING THE HISTORY OF SEDIMENTARY ORGANIC MATTER

I. R. Kaplan, E. Tannenbaum, and B. E. Huizinga *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 82 (For primary document see N86-26844 17-55)

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Results from laboratory simulated pyrolyses experiments show that in addition to depth of burial, preservation of kerogen, and hence any morphologic structure in it, is also dependent on the mineral matrix with which it is associated. In the presence of clay minerals, and especially under dry conditions, extractable lipids released during kerogen decomposition are more rapidly destroyed than in the presence of calcite or chert matrices. The result is production of gas, polar bitumen and pyrobitumen and destruction of biomarkers. During such an early reorganization of the kerogen, the biomarker constituents can be destroyed, or unrecognizably altered. The above process of organic residues maturation appears to be inhibited in the presence of water and is significantly reduced where kerogen is hosted in limestones, dolomites or cherts. These minerals have been characteristically found to be the most reliable in yielding morphological fossils and small quantities of extractable bitumen in Archean and Proterozoic rocks. To understand the validity of chemical and morphological fossils, in the early geologic record, it will be necessary to understand the process of kerogen in sedimentary rocks. To test the role of various minerals on the preservation process, kerogen extracted from a variety of rocks has been heated together with montmorillonite, illite and calcite. The kinetics of the process has been monitored and the products quantitatively identified. M.G.

N86-26885*# Indiana Univ., Bloomington. Biogeochemical Labs.

ISOTOPIC, PETROLOGIC AND BIOGEOCHEMICAL INVESTIGATIONS OF BANDED IRON-FORMATIONS

J. M. Hayes, A. J. Kaufman, C. Klein (New Mexico Univ., Albuquerque), S. A. Studley, M. E. Baur (California Univ., Los Angeles), and M. R. Walter (Bureau of Mineral Resources, Geology and Geophysics, Canberra, Australia) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 84 (For primary document see N86-26844 17-55)

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It is recognized that the first occurrence of banded iron-formations (BIFs) clearly predates biological oxygenation of the atmosphere-hydrosphere system and that their last occurrences extend beyond plausible dates of pervasive biological oxygenation. For this reason, and because enormous quantities of oxidizing power have been sequestered in them, it is widely thought that these massive, but enigmatic, sediments must encode information about the mechanism and timing of the rise of atmospheric O2. By coupling isotopic analyses of iron-formation carbonates with biogeochemical and petrologic investigations, we are studying (1) the mechanism of initial sedimentation of iron; (2) the role of iron in microbially mediated diagenetic processes in fresh iron-formation sediments; and (3) the logical integration of mechanisms of deposition with observed levels of banding. Thus far, it has been shown that (1) carbonates in BIFs of the Hamersley Group of Western Australia are isotopically inhomogenous; (2) the nature and pattern of isotopic ordering is not consistent with a metamorphic origin for the overall depletion of C-13 observed in the carbonates; (3) if biological, the origin of the C-13 depleted carbonate could be either respiratory or fermentative; (4) iron may have been precipitate d as Fe(3+), then reduced to Fe(2+) within the sediment; and (5) sedimentary biogeochemical systems may have been at least partially closed to mass transport of carbonate species. Author

N86-26886*# Michigan Univ., Ann Arbor.

THE LUNAR NODAL TIDE AND THE DISTANCE TO TNE MOON DURING THE PRECAMBRIAN ERA

James C. G. Walker and Kevin J. Zahnle *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 85 (For primary document see N86-26844 17-55)

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The origin and early evolution of life on Earth occurred under physical and chemical conditions distinctly different from those of the present day. The broad goal of this research program is to characterize these conditions. One aspect involves the dynamics of the Earth-Moon system, the distance of the Moon from the Earth, and the length of the day. These have evolved during the course of Earth history as a result of the dissipation of tidal energy. As the moon has receded the amplitude of oceanic tides has decreased while the increasing length of the day should have influenced climate and the circulation of atmosphere and ocean. A 23.3 year periodicity preserved in a 2500 million year old banded iron-formation was interpreted as reflecting the climatic influence of the lunar nodal tide. The corresponding lunar distance would then have been approx. 52 Earth radii. The influence of the lunar nodal tide is also apparent in rocks with an age of 680 million years B.P. The derived value for lunar distance 2500 million years ago is the only datum on the dynamics of the Earth-Moon system during the Precambrian era of Earth history. The implied development of Precambrian tidal friction is in accord with more recent paleontological evidence as well as the long term stability of the lunar orbit. Author

N86-26887*# California Univ., Los Angeles. Dept. of Earth and Space Sciences.

RECENT PROGRESS IN PRECAMBRIAN PALEOBIOLOGY

J. William Schopf *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 87 (For primary document see N86-26844 17-55)

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Ongoing studies at UCLA include the following: (1) investigations in Archean and Proterozoic sequences of various locations; (2) laboratory and field studies of modern microbial biocoenoses (analogues of Precambrian microbial communities) especially those at Laguna Mormona, Baja California, Mexico; (3) development of new laboratory techniques for the separation and concentration of minute cellularly preserved fossils for isotopic and organic geochemical analyses; and (4) assembly of a computerized database for assessment of the timing and nature of major events occurring during Precambrian biotic evolution, and of the potential applicability of ancient microbiotas to problems of global biostratigraphy and biogeography. Author

N86-26888*# Illinois Univ., Urbana.

HIGHER-ORDER STRUCTURE OF rRNA

R. R. Gutell and C. R. Woese *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 88 (For primary document see N86-26844 17-55)

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A comparative search for phylogenetically covarying basepair replacements within potential helices has been the only reliable method to determine the correct secondary structure of the 3 rRNAs, 5S, 16S, and 23S. The analysis of 16S from a wide phylogenetic spectrum, that includes various branches of the eubacteria, archaebacteria, eucaryotes, in addition to the mitochondria and chloroplast, is beginning to reveal the constraints on the secondary structures of these rRNAs. Based on the success of this analysis, and the assumption that higher order structure will also be phylogenetically conserved, a comparative search was initiated for positions that show co-variation not involved in secondary structure helices. From a list of potential higher order interactions within 16S rRNA, two higher-order interactions are presented. The first of these interactions involves positions 570 and 866. Based on the extent of phylogenetic covariation between these positions while maintaining Watson-Crick pairing, this higher-order interaction is considered proven. The other interaction involves a minimum of six positions between the 1400 and 1500 regions of the 16S rRNA. Although these patterns of covariation are not as striking as the 570/866 interaction, the fact that they all exist in an anti-parallel fashion and that experimental methods previously implicated these two regions of the molecule in tRNA function suggests that these interactions be given serious consideration. Author

N86-26889*# Houston Univ., Tex. Dept. of Biochemical Sciences.

THE rRNA EVOLUTION AND PROCARYOTIC PHYLOGENY

George E. Fox *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 89 (For primary document see N86-26844 17-55)

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Studies of ribosomal RNA primary structure allow reconstruction of phylogenetic trees for prokaryotic organisms. Such studies reveal major dichotomy among the bacteria that separates them into eubacteria and archaebacteria. Both groupings are further segmented into several major divisions. The results obtained from 5S rRNA sequences are essentially the same as those obtained with the 16S rRNA data. In the case of Gram negative bacteria the ribosomal RNA sequencing results can also be directly compared with hybridization studies and cytochrome c sequencing studies. There is again excellent agreement among the several methods. It seems likely then that the overall picture of microbial phylogeny that is emerging from the RNA sequence studies is a good approximation of the true history of these organisms. The RNA data allow examination of the evolutionary process in a semi-quantitative way. The secondary structures of these RNAs are largely established. As a result it is possible to recognize examples of local structural evolution. Evolutionary pathways accounting for these events can be proposed and their probability can be assessed. Author

N86-26890*# California Univ., Berkeley. Space Sciences Lab.
INVESTIGATIONS WITH METHANOBACTERIA AND WITH EVOLUTION OF THE GENETIC CODE
Thomas H. Jukes *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 90 (For primary document see N86-26844 17-55)
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Mycoplasma capricolum was found by Osawa et al. to use UGA as the code of tryptophan and to contain 75% A + T in its DNA. This change could have been from evolutionary pressure to replace C + G by A + T. Numerous studies have been reported of evolution of proteins as measured by amino acid replacements that are observed when homologus proteins, such as hemoglobins from various vertebrates, are compared. These replacements result from nucleotide substitutions in amino acid codons in the corresponding genes. Simultaneously, silent nucleotide substitutions take place that can be studied when sequences of the genes are compared. These silent evolutionary changes take place mostly in third positions of codons. Two types of nucleotide substitutions are recognized: pyrimidine-pyrimidine and purine-purine interchanges (transitions) and pyriidine-purine interchanges (transversions). Silent transitions are favored when a corresponding transversion would produce an amino acid replacement. Conversely, silent transversions are favored by probability when transitions and transversions will both be silent. Extensive examples of these situations have been found in protein genes, and it is evident that transversions in silent positions predominate in family boxes in most of the examples studied. In associated research a streptomycete from cow manure was found to produce an extracellular enzyme capable of lysing the pseudomurein-contining methanogen Methanobacterium formicicum. Author

N86-26891*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
IS THE ATPase FROM HALOBACTERIUM SACCHAROVORUM AN EVOLUTIONARY RELIC?
Lawrence I. Hochstein, Wijaya Altekar (Bhabha Research Center (India).), and Hordur Kristjansson *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 91 (For primary document see N86-26844 17-55)
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The ATP Synthase Complex present in the membranes of mitochondria, chloroplasts or bacteria is composed of 2 sectors: FO, an integral membrane protein consisting of 3 subunits mediating proton translocation across the membrane and F1, the catalytic component composed of 5 non-identical subunits. The apparent early origin of the ATP Synthase Complex, as implied by its ubiquitous distribution, seems inconsistent with its structural and functional complexity and raises the question if simpler versions of the ATP Synthase exist. Such an ATP Synthase has been searched for in various Archaebacteria. A purified halobacterial ATPase activity which possesses certain properties consistent with those of an ATP Synthase but which has a different subunit structure is described. M.G.

N86-26892*# California Univ., Irvine.
FUNCTIONAL AND EVOLUTIONARY RELATIONSHIPS BETWEEN BACTERIORHODOPSIN AND HALORHODOPSIN IN THE ARCHAEBACTERIUM, HALOBACTERIUM HALOBIUM
Janos K. Lanyi *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 92 (For primary document see N86-26844 17-55)
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The archaebacteria occupy a unique place in phylogenetic trees constructed from analyses of sequences from key informational macromolecules, and their study continues to yield interesting ideas on the early evolution and divergence of biological forms. It is now known that the halobacteria among these species contain various retinal-proteins, resembling eukaryotic rhodopsins, but with different functions. Two of these pigments, located in the cytoplasmic membranes of the bacteria, are bacteriorhodopsin (a light-driven proton pump) and halorhodopsin (a light-driven chloride pump). Comparison of these systems is expected to reveal structure/function relationships in these simple (primitive?) energy transducing membrane components and evolutionary relationships which had produced the structural features which allow the divergent functions. Findings indicate that very different primary structures are needed for these proteins to accomplish their different functions. Indeed, analysis of partial amino acid sequences from halo-opsin shows already that few if any long segments exist which are homologous to bacterio-opsin. Either these proteins diverged a very long time ago to allow for the observed differences, or the evolutionary clock in the halobacteria runs faster than usual. M.G.

N86-26893*# California Univ., Berkeley. Div. of Molecular Plant Biology.
THIOREDOXINS IN EVOLUTIONARILY PRIMITIVE ORGANISMS
Bob B. Buchanan *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 93 (For primary document see N86-26844 17-55)
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Thioredoxins are low molecular weight redox proteins, alternating between the S-S (oxidized) and SH (reduced) states, that function in a number of biochemical processes, including DNA synthesis, DNA replication, and enzyme regulation. Until recently, reduced ferredoxin was known to serve as the source of reducing power for the reduction of thioredoxins only in oxygenic photosynthetic cells. In all other organisms, the source of hydrogen (electrons) for thioredoxin reduction was considered to be NADPH. It was found that Clostridium pasteurianum, an anaerobic organism normally living in the soil unexposed to light, resembles photosynthetic cells in using ferredoxin for the reduction of thioredoxin. The results reveal the existence of a pathway in which ferredoxin, provides the reducing power for the reduction of thioredoxin via the flavoprotein enzyme, ferredoxinthioredoxin reductase. In related studies, it was found that Chromatium vinosum, an anaerobic photosynthetic purple sulfur bacterium, resembles evolutionarily more advanced micro-organisms in having an NADP-thioredoxin system composed of a single thioredoxin which is reduced by NADPH via NADP-thioredoxin reductase. The adoption of the NADP-thioredoxin system by Chromatium seems appropriate in view of evidence tha the organi sm utilizes ATP-driven reverse electron transport. Finally, results of research directed towards the identification of target enzymes of the ferredoxin/thioredoxin system in a cyanobacterium (Nostoc muscorum), show that thioredoxin-linked photosynthetic enzymes of cyanobateria are similar to those of chloroplasts. It now seems that the ferredoxin/thioredoxin system functions in regulating CO2 assimilation via the reductive pentose phosphate cycle in oxygenic but not anoxygenic photosynthetic cells. M.G.

N86-26894*# Rockefeller Univ., New York.
BIOSYNTHETIC PORPHYRINS AND THE ORIGIN OF PHOTOSYNTHESIS
David Mauzerall, Arthur Ley, and Janet A. Mercer-Smith (Los Alamos National Lab., N. Mex.) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 94 (For primary document see N86-26844 17-55)
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Since the prebiotic atmosphere was anaerobic, if not reducing, a useful function of primordial photosynthesis would have been to photooxidize reduced substrates such as Fe(+2), S(-2) or reduced organic molecules and to emit hydrogen. Experiments have shown that the early biogenic pigments uroporphyrin and coproporphyrin do photooxidize organic compounds and emit hydrogen in the presence of a platinum catalyst. These experiments were carried out in dilute aqueous solution near neutral pH under anaerobic atmosphere, and quantum yields near 10-2 were obtained. Thus relevant prebiotic conditions were maintained. Rather then to further optimize conditions, attempts were made to replace the platinum catalyst by a more prebiotically suitable catalyst. Trials with an Fe4S4(SR)4 cluster, in analogy to the present hydrogenase and

nitrogenase, were not successful. However, experiments using cobalt complexes to catalyze the formation of hydrogen are promising. In analogy with biological photosynthetic systems which group pigments, electron transfer molecules and enzymes in clusters for efficiency, it was found that binding the biogenic porphyrins to the polyvinyl alcohol used to support the platinum catalyst did increase the quantum yield of the reaction. It was also found that ultraviolet light can serve to photo-oxidize porphyrinogens to porphyrins under anaerobic conditions. Thus the formation of the colorless porphyriogens by the extraordinarily simple biosynthetic pathway would not be a problem because of the prevalence of UV light in the prebiotic, anoxic atmosphere. Author

N86-26895*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
OXYGEN AND THE EVOLUTION OF METABOLIC PATHWAYS
Linda L. Jahnke *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 95 (For primary document see N86-26844 17-55)
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While a considerable amount of evidence has been accumulated about the history of oxygen on this planet, little is known about the relative amounts to which primitive cells might have been exposed. One clue may be found in the metabolic pathways of extant microorganisms. While eucaryotes are principally aerobic organisms, a number are capable of anaerobic growth by fermentation. One such eucaryotic microorganism, Saccharomyces cerevisiae, will grow in the complete absence of oxygen when supplemented with unsaturated fatty acid and sterol. Oxygen-requiring enzymes are involved in the synthesis of both of these compounds. Studies have demonstrated that the oxidative desaturation of palmitic acid and the conversion of squalene to sterols occur in the range of 10-(3) to 10(-2) PAL. Thus, if the oxygen requirements of these enzymatic processes are an indication, eucaryotes might be more primitive than anticipated from the microfossil record. Results of studies on the oxygen requirements for sterol and unsaturated fatty acid synthesis in a more primitive procaryotic system are also discussed. M.G.

N86-26896*# California Univ., San Diego, La Jolla.
EVOLUTION OF THIOL PROTECTIVE SYSTEMS IN PROKARYOTES
Robert C. Fahey and Gerald L. Newton *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 96 (For primary document see N86-26844 17-55)
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Biological thiols are essential elements in most aspects of cell function but undergo rapid oxidation to disulfides in the presence of oxygen. The evolution of systems to protect against such oxygen toxicity was essential to the emergence of aerobic life. The protection system used by eukaryotes is based upon glutathione (GSH) and GSH-dependent enzymes but many bacteria lack GSH and apparently use other mechanisms. The objective of this research is to elaborate the thiol protective mechanisms employed by prokaryotes of widely divergent evolutionary origin and to understand why GSH became the central thiol employed in essentially all higher organisms. Thiol-selective fluorescent labeling and HPLC analysis has been used to determine key monothiol components. M.G.

N86-26897*# Florida State Univ., Tallahassee. Dept. of Biological Science.
MICROFOSSILS IN THE ANTARCTIC COLD DESERT: POSSIBLE IMPLICATIONS FOR MARS
E. Imre Friedmann and Roseli Ocampo-Friedmann (Florida Agricultural and Mechanical Univ., Tallahassee) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 97 (For primary document see N86-26844 17-55)
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In the Ross Desert of Antarctica, the principal life form is the cryptoendolithic microbial community in the near-surface layers of porous sandstone rocks. Biological, geological, and climatic factors interact in a complex and precarious balance, making life possible in an otherwise hostile environment. Once this balance is tipped, fossilization sets in. In the reverse case, new colonization of the rock surface may be initiated. As a result, fossilization is contemporary with modern life and both may be simultaneously present in a mosaic pattern. Also, different stages of fossilization are present. The process of fossilization takes place in a nonaquatic environment. If primitive life ever appeared on Mars, it is possible that with increasing aridity, life withdrew into an endolithic niche similar to that in the Antarctic desert. Fossilization in a nonaquatic environment may have set in with the result that traces of past life could be preserved. If such was the case, the study of the fossilization process in Antarctica may hold useful information for the analysis of Martian samples for microfossils. Author

N86-26898*# University of Southern Illinois, Carbondale.
EVOLUTIONARY SIGNIFICANCE OF OSMOREGULATORY MECHANISMS IN CYANOBACTERIA
John H. Yopp, John H. Pavlicek, and Marion H. Sibley *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 98 (For primary document see N86-26844 17-55)
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Physiological processes of all life forms on this planet are intrinsically related to their intracellular water potential. The overall goal was the elucidation of the mechanism(s) whereby the first oxygenic photoautotrophs (the cyanobacteria) adjust their water potential to that of a changing external water potential (that is, osmoregulate). Osmoregulation is achieved by intracellular adjustment of inorganic and/or organic solutes (osmolytes) involving specific biochemical mechanisms. Structural and biochemical evolution within the cyanobacteria is believed completed (and fixed in present day forms) by the end of the Precambrain eon. Therefore, research using cyanobacteria of all three structural types (unicellular, filamentous, and branched), each grown in the photoautotrophic (PA), photoheterotrophic (PG), and chemotrophic (CH) modes of nutrition, should provide insight into the origin and evolution of the photosynthetically related osmoregulatory mechanisms of eukaryotic organisms. The chloroplasts of these organisms are phylogenetically related to the cyanobacteria. Author

N86-26899*# Boston Univ., Mass.
MICROBIAL CONTRIBUTIONS TO THE PRECAMBRIAN EARTH
Lynn Margulis, David Bermudes, and Robert Obar *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 99 (For primary document see N86-26844 17-55)
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Life has existed on Earth for approximately 3.5 billion years. For most of this time, prokaryotic communities provided the major biological forces changing the Earth. Many changes in atmospheric gas composition occurred during the Archean and Proterozoic eons as a result of microbial activity. Extant microbial communities were used to help understand the dynamics which contributed to these atmospheric changes. The microbial mat communities were characterized according to the organismic constituents. Symbiosis in microbial communities is recognized as a major force in cell evolution. Among the evolutinary enigmas investigated is the problem of the origin of the undulipodia. Undulipodial microtubules are still deployed for major cellular processes such as mitosis and meiosis. Several prokaryotes were tested for the presence of the S1-type protein, so far only spirochetes were found to possess it. The S1-type protein is being sought in cyanobacteria reported to contain microtubules. B.G.

N86-26900*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ORGANIC S13C VALUES VARY SLIGHTLY WITH SALINITY IN MICROBIAL MATS AT GUERRERO NEGRO, BAJA CALIFORNIA SUR, MEXICO: IMPLICATIONS FOR STROMATOLITE S13C

VALUES
David J. DesMarais, Etta Peterson, Emil Kwong, and Hua Bui *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 100 (For primary document see N86-26844 17-55)
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Stromatolites, layered sedimentary rock structures produced by communities of microorganisms, constitute the most abundant early evidence of life on Earth. Microbial mats, which are found most frequently in hypersaline marine or hot spring environments, serve as useful modern analogs of stromatolitic communities. Biochemical studies of mats were conducted to assist in the interpretations of stromatolites. The data suggest that salinity effects are insufficient by themselves to cause the C-13 differences observed between Precambrian stromatolites and modern microbial mats. Author

N86-26901*# Chicago Univ., Ill.
THE FOSSIL RECORD OF EVOLUTION: ANALYSIS OF EXTINCTION
David M. Raup *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 102 (For primary document see N86-26844 17-55)
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There is increasing evidence that events in space have had direct effects on Earth history and on the history of life on Earth. Nowhere is this more evident than in mass extinction. The biosphere has undergone repeated devastation caused by relatively short-lived environmental stress, with species kill rates up to 80 and 95%. For five of the mass extinctions, geochemical or other evidence was reported suggesting large body impact as the cause of the environmental stress producing the extinctions. It was argued on statistical ground that the major extinction events are uniformly periodic in geological time. If it is true that large body impact is a principal cause of mass extinctions and if the periodicity is real, than a cosmic driving mechanism is inescapable. Paleontological data sets were developed which detail the ranges in geological time of about 4,000 families and 25,000 genera of fossil marine organisms. Analyses to date have concentrated on the most recent 250 million years. Associated with these studies are analyses of other aspects of Earth history which may have signatures indicative of extraterrestrial effects. Author

N86-26902*# Chicago Univ., Ill.
THE FOSSIL RECORD OF EVOLUTION: DATA ON DIVERSIFICATION AND EXTINCTION
J. John Sepkoski, Jr. *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 102 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

Synoptic studies of the fossil record of complex life on Earth indicate increasingly that extinction, and especially mass extinction, were extremely important driving forces in the history of life. Analysis of a new compilation of geologic ranges for 25,000 genera of marine animals suggests that extinction events were much more frequent in occurrence and variable in magnitude than previously suspected. At least 30 well documented and potential mass extinctions were identified in the dataset. The most recent event, distributed over 260 to 0 ma. exhibit a stationary periodicity of 26.1 + or - 1 ma, implicating a cosmological forcing mechanism. Earlier events, especially in the 575 to 450 ma interval, are more frequent, possibly indicating either a breakdown of periodicity in the more distant past; and as yet undemonstrated diminution of the period length; or frequent aperiodic terrestrial perturbations of a less stable biota superimposed upon the cosmological periodicity. Author

N86-26903*# California Univ., Berkeley. Lawrence Berkeley Lab.
GEOCHEMICAL ANOMALIES, BOLIDE IMPACTS AND BIOLOGICAL EXTINCTIONS ON THE EARTH
Frank Asaro, Luis W. Alvarez, H. V. Michel, and W. Alvarez (California Univ., Berkeley.) *In* NASA, Washington Second Symposium in Chemical Evolution and the Origin and Evolution of Life May 1986 p 104 (For primary document see N86-26844 17-55)
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Geochemical and mineralogical techniques are used to search for evidence of extraterrestrial impacts associated with mass and lesser biological extinction peaks in the geological record. Studies of the Cretaceous-Tertiary boundary serve as a baseline for evaluating geochemical data from the extinction horizones. Other studies were generally concentrated on rock strata corresponding to the periodic extinction peaks noted by Raup and Sepkoski. A significant iridium anomaly in late Eocene marine sediments associated with extinctions of radiolaria in low latitudes and attributed to an extraterrestrial source is widely distributed in 8 to 9 sites around the world. Author

N86-26904*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CLIMATIC CONSEQUENCES OF VERY HIGH CO2 LEVELS IN EARTH'S EARLY ATMOSPHERE
James F. Katsing *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 105 (For primary document see N86-26844 17-55)
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Earth has approximately 60 bars of carbon dioxide tied up in carbonate rocks, or roughly 2/3 the amount of CO2 of the atmosphere of Venus. Two different lines of evidence, one based on thermodynamics and the other on geochemical cycles, indicate that a substantial fraction of thes CO2 may have resided in the atmosphere during the first few hundred million years of the Earth's history. A natural question which arises is whether this much CO2 would have resulted in a runaway greenhouse effect. One dimensional radiative/convective model calculations presented showed that the surface temperature of a hypothetical primitive atmosphere containing 20 bars of CO2 was less than 100 C; thus no runaway greenhouse effect would have occurred. The climatic stability of the early atmosphere is a consequence of three factors: reduced solar luminosity at that time, an increase in planetary albedo caused by Rayleigh scattering by CO2, and the stabilizing effects of a moist convection. The latter two factors are sufficient to prevent a CO2 induced runaway greenhouse effect on the present Earth as well, for CO2 levels up to 100 bars. Further studies are being undertaken to determine whether a runaway greenhouse effect could have occurred during the latter stages of the accretion process and, if so, whether it would have collapsed one the influx of material slowed down. Author

N86-26905*# Ohio State Univ., Columbus.
A DECADE OF SETI OBSERVATIONS
Robert S. Dixon *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 107 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

A full time dedicated search for extraterrestrial radio signals of intelligent origin has been in progress at the Ohio State University Radio Observatory since 1973. The radio telescope has a collecting area of 2200 square meters, which is equivalent to a circular dish 175 feet in diameter. The search concentrates on a 500 kHz bandwidth centered on the 1420 MHz hydrogen line, Doppler corrected to the galactic standard of rest. A large portion of the sky visible from Ohio was searched, with particular emphasis on the galactic center region and the M31 Andromeda galaxy. The survey is largely computer automated, and all data reduction is done in real time. Two distinct populations of signals were detected. The first is a relatively small number of signals which persist for over a minute and which are clearly extraterrestrial in origin. The second is the large number of signals which persist less than 10 seconds whose locations are anticorrelated with the galactic plane but show clumps along the galactic axis. None of these signals were observed to recur, despite repeated observations. The cause of these signals were not determined. Author

N86-26906*# California Univ., Berkeley. Space Sciences Lab.
THE BERKELEY SERENDIP PROJECT
Stuart Bowyer, Dan Werthimer, Jill Tarter, and Rachael Buhse *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 108 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

An automated system was designed to perform a real time search for narrow band radio signals in the spectra of sources in a regularly scheduled, non-SETI astronomical observing program. The system will compute the power spectrum using a 65, 536 channel fast Fourier transform processor with a real time bandwidth of 128 KHz and 2 Hz per channel resolution. After search for peaks in a 100 KHz portion of the IF band of the radio telescope, the system will move to the next 100 KHz portion using a programmable frequency synthesizer. When the whole IF band is scanned, the process will start again. Unidentified peaks in the power spectra are candidates for further study and their celestial coordinates will be recorded along with the time and power, IF and RF frequency, and bandwidth of the peak. Most of the hardware was developed and the machine software is in the process of being finalized. A number of means for identifying and rejecting power spectra peaks which have a high likelihood of being nonuseful are being investigated. Author

N86-26907*# California Univ., Berkeley. Space Sciences Lab.
AN INFRARED SEARCH FOR EXTRATERRESTRIAL LASER SIGNALS
Albert Betz *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 109 (For primary document see N86-26844 17-55)
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The focus of project SETI is on microwave frequencies, where receivers fundamentally have the best sensitivity for the detection of narrow band signals. Such receivers, when coupled to existing radio telescopes, form an optimum system for broad area searches over the sky. Detection of narrow band infrared signals is best done with a laser heterodyne reciever similar in function to a microwave spectral line receiver. A receiver was built for astrophysical observations at 30 THz (10 microns) and the spectrometer is being adapted for SETI work. The receiver uses a small CO2 laser as the local oscillator, a HgCdTe diode as the photomixer, and a multichannel intermediate frequency (IF) filterbank. An advanced multichannel IF processor is now being built to detect infrared line radiation in 1000 spectral channels each 1 MHz wide. When completed this processor will be used with a ground based telescope next year for a survey of several hundred selected stars for narrow band CO2 laser signals at 30 THz. Author

N86-26908*# Boston Univ., Mass. Dept. of Astronomy.
USING THE IRAS DATA TO SEARCH IN THE ASTEROID BELT FOR ANY POTENTIAL EVIDENCE OF GALACTIC COLONIZATION
Michael D. Papagiannis *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 110 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

The end product of the biological evolution seems to be the appearance of technological civilizations, which are characterized by superior technology that supercedes biological capabilities. The Search for Extraterrestrial Intelligence (SETI) has gained scientific recognition in recent years. The concept of galactic colonization is debated extensively, with opinions ranging from the impossible to the inevitable, but without a clear resolution. Answers can be obtained only with experimental tests and not with endless debates. A search for large space colonies in the asteroid belt, an ideal source of raw materials for a spaceborne civilization, is a test of the galactic colonization theory. The catalogue of solar system objects obtained form the Infrared Astronomy Satellite (IRAS) observations at 12, 25, 60, and 100 microns, is an ideal source for such a search. The catalog is expected to be ready at the end of 1985 and will contain more than 10,000 objects. B.G.

N86-26909*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
OVERVIEW OF THE NASA SETI PROGRAM
Bernard M. Oliver *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 111 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

The NASA Search of Extraterrestrial Intelligence (SETI) program plan is to scan the microwave window from 1 to 10 GHz with existing radio telescopes and sophisticated signal processing equipment looking for narrow band features that might represent artificial signals. A microwave spectrometer was built and is being field tested. A pattern recognition computer to search for drifting continuous wave signals and pulse trains in the output spectra is being designed. Equipment to characterize the radio frequency interference environment was also built. The plan is to complete the hardware and software by FY-88. Then, with increased funding, this equipment will be replicated in Very Large Scale Integration form. Observations, both a complete sky survey and a search fo nearby solar type stars, will begin in about 1990. The hypothesis that very powerful signals exist or that signals are being beamed at us will be tested. To detect the kinds of signals radiated at distances of 100 light years will require a collecting area kilometers in diameter. Author

N86-26910*# Stanford Univ., Calif. Radioscience Lab.
STANFORD HARDWARE DEVELOPMENT PROGRAM
Allen Peterson, Ivan Linscott, and Jim Burr *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 112 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

Architectures for high performance, digital signal processing, particularly for high resolution, wide band spectrum analysis were developed. These developments are intended to provide instrumentation for NASA's Search for Extraterrestrial Intelligence (SETI) program. The real time signal processing is both formal and experimental. The efficient organization and optimal scheduling of signal processing algorithms were investigated. The work is complemented by efforts in processor architecture design and implementation. A high resolution, multichannel spectrometer that incorporates special purpose microcoded signal processors is being tested. A general purpose signal processor for the data from the multichannel spectrometer was designed to function as the processing element in a highly concurrent machine. The processor performance required for the spectrometer is in the range of 1000 to 10,000 million instructions per second (MIPS). Multiple node processor configurations, where each node performs at 100 MIPS, are sought. The nodes are microprogrammable and are interconnected through a network with high bandwidth for neighboring nodes, and medium bandwidth for nodes at larger distance. The implementation of both the current mutlichannel spectrometer and the signal processor as Very Large Scale Integration CMOS chip sets was commenced. Author

N86-26911*# California Univ., Berkeley. Dept. of Astronomy.
GOLDSTONE FIELD TEST ACTIVITIES: TARGET SEARCH
Jill Tarter *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 113 Prepared in cooperation with Search for Extraterrestrial Intelligence Inst., Los Altos, Calif. (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

In March of this year prototype SETI equipment was installed at DSS13, the 26 meter research and development antenna at NASA's Goldstone complex of satellite tracking dishes. The SETI equipment will remain at this site at least through the end of the summer so that the hardware and software developed for signal detection and recognition can be fully tested in a dynamic observatory environment. The field tests are expected to help understand which strategies for observing and which signal recognition algorithms perform best in the presence of strong man-made interfering signals (RFI) and natural astronomical sources. Author

N86-26912*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
GOLDSTONE FIELD TEST ACTIVITIES: SKY SURVEY
Samuel Gulkis and Edward T. Olsen *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 114 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

The goals are to conduct a research and development program aimed at determining the most effective way to do SETI within the constraints of current technology and estimated budgets. The general search strategy adopted is that which is recommended by the SETI Science Working Group. The strategy for an all sky survey for SETI was further developed over the last year. Scan patterns, scan rates, and signal detection algorithms were developed. Spectral power measurement instrumentation was tested at the Venus Station of the Goldstone Deep Space Communication Complex. A specially designed radio frequency interference (RFI) measurement system was built and installed at the Venus Station. A data base management system for storage and retrieval of the RFI data was partially implemented on a VAX 750 computer at the Jet Propulsion Laboratory. Author

N86-26913# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
JPL'S ROLE IN THE SETI PROGRAM
Michael J. Klein *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin of Life May 1986 p 115 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

The goal of the JPL SETI Team is to develop the strategies and the instrumentation required to carry out an effective, yet affordable, SETI Microwave Observing Program. The primary responsibility for JPL is the development and implementation of the Sky Survey component of the bimodal search program recommended by the SETI Science Working Group (NASA Technical Paper 2244, 1983). JPL is also responsible for the design and implementation of microwave analog instrumentation (including antenna feed systems, low noise RF amplifiers, antenna monitor and control interfaces, etc.) to cover the microwave window for the Sky Survey and the Target Search observations. The primary site for the current SETI Field Test activity is the Venus Station of the Goldstone Deep Space Communication Complex. A SETI controller was constructed and installed so that pre-programmed and real time SETI monitor and control data can be sent to and from the station controller. This unit will be interfaced with the MCSA. A SETI Hardware Handbook was prepared to describe the various systems that will be used by the project at the Venus Station; the handbook is frequently being expanded and updated. The 65,000 channel FFT Spectrum analyzer in the RFI Surveillance System was modified to permit operation with variable resolutions (300 Hz to less than 1 Hz) and with real-time accumulation, which will enhance the capability of the system for testing Sky Survey search strategies and signal detection algorithms. Author

N86-27152*# National Aeronautics and Space Administration, Washington, D.C.
EXOBIOLOGY EXPERIMENT CONCEPTS FOR SPACE STATION
L. D. Griffiths (Management and Technical Services Co., Washington, D.C.) and D. L. DeVincenzi *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 1 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N86-26914*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INCREASING PROCESSOR UTILIZATION DURING PARALLEL COMPUTATION RUNDOWN
William H. Jones 1986 13 p refs Presented at the 1986 International Conference on Parallel Processing, St. Charles, Ill., 19-22 Aug. 1986; sponsored by IEEE
(NASA-TM-87349; E-3101; NAS 1.15:87349) Avail: NTIS HC A02/MF A01 CSCL 09B

Some parallel processing environments provide for asynchronous execution and completion of general purpose parallel computations from a single computational phase. When all the computations from such a phase are complete, a new parallel computational phase is begun. Depending upon the granularity of the parallel computations to be performed, there may be a shortage of available work as a particular computational phase draws to a close (computational rundown). This can result in the waste of computing resources and the delay of the overall problem. In many practical instances, strict sequential ordering of phases of parallel computation is not totally required. In such cases, the beginning of one phase can be correctly computed before the end of a previous phase is completed. This allows additional work to be generated somewhat earlier to keep computing resources busy during each computational rundown. The conditions under which this can occur are identified and the frequency of occurrence of such overlapping in an actual parallel Navier-Stokes code is reported. A language construct is suggested and possible control strategies for the management of such computational phase overlapping are discussed. Author

N86-26915*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPUTATIONAL METHODS FOR THE CONTROL OF DISTRIBUTED PARAMETER SYSTEMS
J. A. Burns (Virginia Polytechnic Inst. and State Univ., Blacksburg.), E. M. Cliff, and R. K. Powers May 1986 19 p refs Sponsored in part by LLNL
(Contracts NAS1-17070; NAS1-18107; Grants NSF ECS-81-09245; AF-AFOSR-0287-85)
(NASA-CR-178108; ICASE-86-32; NAS 1.26:178108) Avail: NTIS HC A02/MF A01 CSCL 12A

Finite dimensional approximation schemes that work well for distributed parameter systems are often not suitable for the analysis and implementation of feedback control systems. The relationship between approximation schemes for distributed parameter systems and their application to optimal control problems is discussed. A numerical example is given. Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.
For components see *33 Electronics and Electrical Engineering.*

N86-26916# Los Alamos National Lab., N. Mex.
NETWORK FILE STORAGE SYSTEM
M. W. Collins 1985 12 p Presented at the 7th Symposium on Mass Storage Systems, Tucson, Ariz., 4-7 Nov. 1985
(Contract W-7405-eng-36)
(DE86-000779; LA-UR-85-3183; CONF-8511114-1) Avail: NTIS HC A02/MF A01

The CFS is a centralized file management and file storage for the Los Alamos Integrated Computing Network (ICN). The ICN is composed of over 70 computers running 5 different timesharing operating systems. CFS has been operational since June 1979 in a scientific computing environment (primarily interactive but including batch), using the latest supercomputers. CFS allows controlled data sharing between the network computers and between users, as any file stored in CFS can be retrieved on any

of the network computers provided the user has access to the file and meets security rules. The user interface to CFS is simple and flexible and was designed for optimum performance with an interactive user. The network interface is also simple and flexible. This is a better approach than a network storage system that is integrated with the operating systems of the network computers. The ICN is constantly changing, so the interfaces between the components must be simple. Most of the CFS user interface decision is placed at the user level to allow the user to retain the maximum control and flexibility. DOE

N86-26917# Los Alamos National Lab., N. Mex.
CFT COMPILER OPTIMIZATION AND CRAY X-MP VECTOR PERFORMANCE
I. Y. Bucher and M. L. Simmons 1985 9 p Presented at the Cray Users Group Meeting, Montreal, Quebec, 30 Sep. - 3 Oct. 1985
(Contract W-7405-eng-36)
(DE86-004746; LA-UR-85-4404; CONF-8509219-1) Avail: NTIS HC A02/MF A01

The motivation for this paper was the observation that Cray X-MP vector performance has not always improved. It is well known that vector performance of register-to-register vector computers is strongly compiler dependent. The compiler is responsible for properly sequencing vector load, arithmetic, and store operations, and for scheduling necessary scalar operations in such a way that they take place while vector operations are in progress and therefore do not consume any additional time. We have analyzed vector performance data for CFT compiler versions 1.10 through 1.14. In spite of the great performance improvements achieved by version 1.14 of CFR, further speedups are possible by eliminating the slowdowns introduced in version 1.11. DOE

N86-26918# Yale Univ., New Haven, Conn. Dept. of Computer Science.
FOUNDATIONS OF KNOWLEDGE FOR DISTRIBUTED SYSTEMS. REVISION
Michael J. Fisher and Neil Immerman Dec. 1985 19 p refs
(Contract N00014-82-K-0154; Grant NSF DCR-84-05478)
(AD-A163545; Yaleu/DCS/TR-450-Rev) Avail: NTIS HC A02/MF A01 CSCL 09/2

We give a simple, yet very general definition for distributed protocols. We then define notions of knowledge and common knowledge appropriate for these protocols. We study how changes in the states of knowledge relate to more standard notions of computation. We find that by restricting our formulas to certain sets of global states we can realize different, appropriate definitions of knowledge with fundamentally different properties. GRA

N86-26919# Georgia Inst. of Tech., Atlanta. School of Information and Computer Science.
PROCEEDINGS OF THE INTERNATIONAL TEST AND EVALUATION ASSOCIATION 1984 SYMPOSIUM (STEP SESSION). SUPPLEMENT
Apr. 1985 102 p
(Grant F33657-82-G-2083)
(AD-A163236; GIT-ICS-85/05-Suppl) Avail: NTIS HC A06/MF A01 CSCL 09/2

The motivation for this session of the ITEA symposium is to demonstrate some good examples of software testing in the DoD and to update the test community on some current activities of the DoD to improve the testing of software. The session is organized around three technical areas: 1) The Software T&E Policy and Guidance section is concerned with presenting policy level changes to DoDD 5000.3 that will improve the visibility and accountability of softwafe in major systems acquisitions. Included in this section is a presentation of a guidebook that will be issued to aid in implementing DoD policy. 2) The Software Test Management section presents two perspectives of the management of software testing during development test and operational test. 3) The Software Test Tools section describes the effectiveness of using software test tools on two DoD programs. In addition, it describes the to-be-issued DoD-StD-SDS and SOS, the new Joint Logistics Commanders Standards for software development and software quality assurance. GRA

N86-26920# Texas Instruments, Inc., Dallas. Central Research Labs.
CHOOSING ARCHITECTURES FOR EXPERT SYSTEMS Final Report, Jul. 1983 - Mar. 1985
Paul J. Kline and Steven B. Dolins Oct. 1985 158 p
(Contract F30602-83-C-0123)
(AD-A163343; RADC-TR-85-192) Avail: NTIS HC A08/MF A01 CSCL 09/2

Design guidelines for expert systems are developed. These guidelines relate problem characteristics to appropriate artificial intelligence (AI) implementation techniques. They were developed by (1) collecting claims about the appropriate use of techniques from the published literature on expert systems, (2) circulating these draft guidelines among experienced expert systems builders for their comments and additions, and (3) revising the draft guidelines in response to these comments. This report includes the resulting 47 guidelines along with excerpts from the published literature that justify and support each guideline. The report also contains descriptions of 44 problems readers can be expected to encounter if they decide to use some of the AI techniques that are recommended. A glossary that defines 53 of the AI techniques and an index are also included. Author (GRA)

N86-26921# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Sci.
INTERPROCESSOR COMMUNICATION ISSUES IN FAT-TREE ARCHITECTURES
Alexander Toichi Ishii Oct. 1985 43 p
(Contract N00014-80-C-0622)
(AD-A163425) Avail: NTIS HC A03/MF A01 CSCL 09/2

In recent years, it has become increasingly evident that conventional computer architectures will be unable to perform, in an acceptable time frame, many of the computational functions that we would desire of them. Consequently, much research has been devoted to the concept of constructing super-computers, which will be able to exploit the potential for parallel computation intrinsic to many large computational problems. Recently, Leiserson has proposed a multiprocessor scheme based on Leighton's tree of meshes, called a fat-tree. Conceptually, such a multiprocessor would be comprised of a set of n processing elements each situated as a leaf in a complete binary tree. Internal modes would be high speed switches which route messages being passed between processing elements, while edges between nodes would be bundles of constant bandwidth communication paths. The purpose of this document will be to address and define some of the issues which effect interprocessor communication within a fat-tree multiprocessor. Specifically, it covers the following topics: (1) Addressing in a fat-tree; (2) Generation of addresses in a fat-tree; and (3) Allocation of communication resources in a fat-tree. GRA

N86-26922# University of Southern California, Los Angeles. Computer Research Inst.
SYNTHESIS OF HIGH-SPEED DIGITAL SYSTEMS Ph.D. Thesis
Nohbyung Park 8 Nov. 1985 232 p
(Contracts DAAG29-83-K-0147; DAAG29-80-K-0083)
(AD-A164690; CRI-85-23; ARO-20637.11-EL) Avail: NTIS HC A11/MF A01 CSCL 09/2

The design of high-speed systems and the automation of the design tasks involved is the topic of this thesis. In particular, the focus is on the use of pipelining and general overlapped execution in order to speed up the systems being implemented. This thesis contains new techniques for speed-up, and describes the implementation of these techniques in a set of design automation programs. The new techniques produce designs which share resources and time in a manner which is more complex that used as common practice in working systems. The manual design of such complex hardware would be virtually impossible; thus, automated design is a key aspect of the proposed design

methodology. The specific problem the thesis addresses is the following: the determination of the point in time each operation in a set of tasks is to be performed, and the manner in which the operators which execute each operation are reused from cycle to cycle. Three topics are investigated: 1) clocking scheme synthesis; 2) synthesis of pipelined data paths; and, 3) the insertion of delays into pipelined systems to avoid resources conflicts while increasing performance. GRA

N86-26923# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPUTERS AND DATA TRANSMISSION EQUIPMENT. ALPHA-NUMERIC CODES
4 Feb. 1986 13 p Transl. into ENGLISH from Russian State Standard GOST 13052-67, 1967 p 1-14 Supersedes FTD-ID(RS)T-0041-86
(AD-A164794; FTD-ID(RS)T-0041-86; FTD-HT-23-652-69) Avail: NTIS HC A02/MF A01 CSCL 09/2

In a translation of a Soviet document a standard is extended to a binary seven-element code (symbols and their code designations), which is intended for the representation of information at the inputs and outputs of the data transmission equipment, electronic computers, and input/output units. GRA

N86-26924# Naval Postgraduate School, Monterey, Calif.
MODERN HARDWARE TECHNOLOGIES AND SOFTWARE TECHNIQUES FOR ON-LINE DATABASE STORAGE AND ACCESS M.S. Thesis
Christopher V. Feudo Dec. 1985 297 p refs
(AD-A164993) Avail: NTIS HC A13/MF A01 CSCL 09/2

Computerized data processing applications have grown over the past thirty years to a point where they have now become a pervasive influence in our society. As the range of applications has grown, a continuing concern has been the cost and access time of data storage. A wide range of technologies have been investigated to address this problem. The purpose of this thesis is to examine high volume, on-line storage media of current and emerging technologies and software techniques for supporting these on-line, high capacity storage media. In the first part, we analyze such media as vertical magnetic recording, thin film media, optical data disks, magneto-optic disks, bubble and Bernoulli-effect disks. Then, comparisons and evaluations of products and product categories are illustrated. In the second part, we review the modern software techniques for on-line database storage and access.
Author (GRA)

N86-26925# Naval Postgraduate School, Monterey, Calif.
THE FEASIBILITY OF AUTOMATIC STORAGE RECLAMATION WITH CONCURRENT PROGRAM EXECUTION IN A LISP ENVIRONMENT M.S. Thesis
Kevin G. Cassidy Dec. 1985 108 p
(AD-A165184) Avail: NTIS HC A06/MF A01 CSCL 09/2

Storage reclamation is the process of reclaiming discarded information and returning the memory space occupied by that discarded information to an available area or list in memory that is available to be utilized by programmers. This increased interest in storage reclamation is a result of the increasing use of list-processing environments. A list-processing environment is a system in which the language manipulates data structures called lists. In classical LISP implementations, program execution/computation continues until there is no more memory available (i.e., the free list of available cells has become exhausted). When this happens, user program(s) HALT and then storage reclamation, in the form of garbage collection, takes over. This halting of programs in the midst of their computation is not only frustrating to programmers and researchers but can also be of crucial importance in other applications. This thesis investigates the feasibility of allowing concurrent program execution with garbage collection. LISP has been selected because it has been estimated that typical LISP programs take 10%-30% of their processing time to perform garbage collection. GRA

N86-26926# Naval Biodynamics Lab., New Orleans, La.
DEMONSTRATION OF A STATISTICAL METHOD FOR ISOLATING TIMESHARING COMPONENTS
Alvah C. Bittner, Jr. and Diane L. Damos Jan. 1986 21 p
(AD-A165417; NBDL-86R001) Avail: NTIS HC A02/MF A01 CSCL 09/2

An objective statistical method for isolating timesharing components of performance is described and demonstrated. During the first stage of this method, partial correlation analysis is used to remove the variance attributable to the single-task measures. During the second stage, the resulting dual-task partial correlations are subjected to a form of factor analysis. Data from both Sverko (1977) and Wickens, Mountford, and Schreiner (1981) were reanalyzed and the results compared with their earlier analyses, as well as with the reanalysis of the later study by Ackerman, Schneider and Wickens (1984). The characterization of timesharing factors and the question of a general timesharing factor are also discussed. Using the proposed method, substantial evidence for multiple timesharing components was found.
Author (GRA)

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N86-26927 Royal Signals and Radar Establishment, Malvern (England). Inst. of Sound and Vibration Research.
REGULAR EXPRESSION ANALYSIS OF PROCEDURES AND EXCEPTIONS
J. M. Foster Jun. 1985 22 p refs
(RSRE-85008; BR97966; ESA-86-96846) Copyright. Avail: Issuing Activity

An algorithm to find properties of computer programs by using algebraic methods is described. It is capable of handling subroutines and exception exits. A program scheme to find properties of microcode programs was produced. The scheme can be systematically instantiated to deal with particular properties. The algorithm works in practice, even for very complex microcode, in time proportional to the number of microcode instructions. ESA

N86-26928*# Stanford Univ., Calif. Computer Systems Lab.
EXECUTAABLE ASSERTIONS AND FLIGHT SOFTWARE
Aamer Mahmood, Dorothy M. Andrews, and E. J. McCluskey Nov. 1984 35 p refs Previously announced in IAA as A85-17854
(NASA-CR-176759; NAS 1.26:176759; CSL-TR-84-258; CRC-TR-84-16) Avail: NTIS HC A03/MF A01 CSCL 09B

Executable assertions are used to test flight control software. The techniques used for testing flight software; however, are different from the techniques used to test other kinds of software. This is because of the redundant nature of flight software. An experimental setup for testing flight software using executable assertions is described. Techniques for writing and using executable assertions to test flight software are presented. The error detection capability of assertions is studied and many examples of assertions are given. The issues of placement and complexity of assertions and the language features to support efficient use of assertions are discussed. Author

N86-26929# Argonne National Lab., Ill. Mathematics and Computer Science Div.
SPECFUN - A PORTABLE SPECIAL FUNCTION PACKAGE
W. J. Cody 1985 13 p Presented at the Workshop on Microcomputers in Large Scale Scientific Computing, Newark, Del.
(Contract W-31-109-eng-38)
(DE86-004060; CONF-8505216-1) Avail: NTIS HC A02/MF A01

SPECFUN is a collection of transportable Fortran special function programs and accompanying test drivers that is currently under development. Elements of the package have been success-

fully run on machines as diverse in characteristics as a Kaypro II, an IBM PC, a VAX 11/780, an IBM 3033, and Cray-1. This is a discussion of the overall capabilities, design characteristics, and implementation details of the package. DOE

N86-26930# Lawrence Livermore National Lab., Calif.
ALGORITHMS FOR SUPERCOMPUTERS
B. J. Alder Dec. 1985 20 p Presented at Congress Submitted for publication
(Contract W-7405-eng-48)
(DE86-004480; UCRL-93705; CONF-850859-3) Avail: NTIS HC A02/MF A01

Better numerical procedures, improved computational power and additional physical insights have contributed significantly to progress in dealing with classical and quantum statistical mechanics problems. Past developments are discussed and future possibilities outlined. DOE

N86-26931# Royal Signals and Radar Establishment, Malvern (England). Inst. of Sound and Vibration Research.
EXTENDING DATA TYPING BEYOND THE BOUNDS OF PROGRAMMING LANGUAGES
M. Stanley Sep. 1985 13 p
(RSRE-MEMO-3878; BR97889; ESA-86-96847) Avail: Issuing Activity

The use of strongly typed values at the operating system and command language level in a Programming Support Environment (PSE) is discussed. The use of flexible data structures on filestore, with support for data typing from the operating system and the command language interpreter, as implemented in the Flex PSE, is outlined. ESA

N86-26932*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
A LATERAL GUIDANCE ALGORITHM TO REDUCE THE POST-AEROBRAKING BURN REQUIREMENTS FOR A LIFT-MODULATED ORBITAL TRANSFER VEHICLE M.S. Thesis
Glen Charles Herman Jun. 1986 155 p
(Contract NAS9-17560)
(NASA-CR-177295; NAS 1.26:177295; CSDL-T-912) Avail: NTIS HC A08/MF A01 CSCL 09B

A lateral guidance algorithm which controls the location of the line of intersection between the actual and desired orbital planes (the hinge line) is developed for the aerobraking phase of a lift-modulated orbital transfer vehicle. The on-board targeting algorithm associated with this lateral guidance algorithm is simple and concise which is very desirable since computation time and space are limited on an on-board flight computer. A variational equation which describes the movement of the hinge line is derived. Simple relationships between the plane error, the desired hinge line position, the position out-of-plane error, and the velocity out-of-plane error are found. A computer simulation is developed to test the lateral guidance algorithm for a variety of operating conditions. The algorithm does reduce the total burn magnitude needed to achieve the desired orbit by allowing the plane correction and perigee-raising burn to be combined in a single maneuver. The algorithm performs well under vacuum perigee dispersions, pot-hole density disturbance, and thick atmospheres. The results for many different operating conditions are presented. Author

N86-26933*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
AN ADAPTIVE GUIDANCE ALGORITHM FOR AN AERODYNAMICALLY ASSISTED ORBITAL PLANE CHANGE MANEUVER M.S. Thesis
James A. Blissit May 1986 229 p
(Contract NAS1.18061)
(NASA-CR-177296; NAS 1.26:177296; CSDL-T-902) Avail: NTIS HC A13/MF A01 CSCL 09B

Using analysis results from the post trajectory optimization program, an adaptive guidance algorithm is developed to compensate for density, aerodynamic and thrust perturbations during an atmospheric orbital plane change maneuver. The maneuver offers increased mission flexibility along with potential fuel savings for future reentry vehicles. Although designed to guide a proposed NASA Entry Research Vehicle, the algorithm is sufficiently generic for a range of future entry vehicles. The plane change analysis provides insight suggesting a straight-forward algorithm based on an optimized nominal command profile. Bank angle, angle of attack, and engine thrust level, ignition and cutoff times are modulated to adjust the vehicle's trajectory to achieve the desired end-conditions. A performance evaluation of the scheme demonstrates a capability to guide to within 0.05 degrees of the desired plane change and five nautical miles of the desired apogee altitude while maintaining heating constraints. The algorithm is tested under off-nominal conditions of + or -30% density biases, two density profile models, + or -15% aerodynamic uncertainty, and a 33% thrust loss and for various combinations of these conditions. Author

N86-26934# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
ERROR PROPERTIES OF HARTLEY TRANSFORM ALGORITHMS
Avideh Zakhor Oct. 1985 204 p
(Contract N00014-81-K-0742; Grant NSF ECS-84-07285; NR Proj. 049-506)
(AD-A163217; TR-511) Avail: NTIS HC A10/MF A01 CSCL 12/1

In this thesis, the error properties of various discrete Hartley transform (DHT) algorithms are investigated theoretically and experimentally. More specifically, the author analyzes the arithmetic roundoff error characteristics of DHT algorithms proposed by Bracewell and Wang and develops and analyzes a new DHT algorithm. Statistical models for roundoff errors and linear system noise theory are employed to estimate output noise variance for these DHT algorithms. By considering the overflow constraint in conjunction with these noise analyses, output noise to signal ratios are derived for both fixed and floating-point arithmetic. Experiments are used to support the theoretical predictions obtained via the statistical models. The empirical results are found to be in excellent agreement with the predictions based on the models. Comparing Bracewell's, Wang's and the new algorithm in terms of their error properties, it is found that Bracewell's algorithm exhibits the most desirable error characteristics. These results were found to hold for both frequency and decimation-in-time and for a variety of different radices. For a given radix, the total operation count for all algorithms is found to be identical.to be identical Author (GRA)

N86-26935# Rockwell International Corp., Los Angeles, Calif.
CADS: A COMPUTER AIDED DESIGN SYSTEM. VOLUME 2. USER'S GUIDE Final Report, 1 Dec. 1981 - 30 Apr. 1985
Michael C. Less and Susan Manuel Aug. 1985 231 p
(Contract F33615-81-C-3229)
(AD-A163258; AFWAL-TR-85-3066-Vol-2) Avail: NTIS HC A11/MF A01 CSCL 09/2

A user's guide for the Computer Aided Design System, CADS. CADS is a pre and post processor for structural analysis and optimization programs based on the finite element method is presented. The system supports five functional modules controlled by an Executive Monitor. All of these modules communicate with a data base through a data manager. In addition a post output translator, CADSPP, is available which processes output from finite element programs, e.g. NASTRAN, directly into the data base. Also given is a detailed description of all user commands available in CADS and CADSPP. A sample session is provided which shows the user commands applied to a variety of sample problems. Author (GRA)

N86-26936# Institute for Defense Analyses, Alexandria, Va.
STARS (SOFTWARE TECHNOLOGY FOR ADAPTABLE AND RELIABLE SYSTEMS) METHODOLOGY AREA SUMMARY. VOLUME 1: ORGANIZATION AND PLANS Final Report
Robert Converse, Catherine W. McDonald, William Riddle, and Christine Youngblut Mar. 1985 33 p
(Contract MDA903-84-C-0031)
(AD-A163270; AD-E500743; IDA-P-1814-Vol-1; IDA/HQ-85-29621-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 09/2

Initially, the Ada Joint Program Office (AJPO) sponsored Professors Peter Freeman and Anthony Wasserman to identify requirements for software development methodologies that would allow the Department of Defense (DoD) to realize the full potential of Ada. Since that time, the work on methodologies to support Ada has been transferred to the DoD Joint Program Office for the program entitled Software Technology for Adaptable and Reliable Systems (STARS). The STARS Joint Program Office (SJPO) objective is to improve the productivity level of software system development and support as well as the resulting quality of deployed software systems. This report consists of two volumes: Volume I presents the organization and plans of the STARS Methodology Coordination Team. Volume II is a technical report concerned with the development of methodology classification, evaluation and selection technologies and a framework of characteristics that can be used to support these technologies. GRA

N86-26937# Institute for Defense Analyses, Alexandria, Va.
STARS (SOFTWARE TECHNOLOGY FOR ADAPTABLE AND RELIABLE SYSTEMS) METHODOLOGY AREA SUMMARY. VOLUME 2: PRELIMINARY VIEWS ON THE SOFTWARE LIFE CYCLE AND METHODOLOGY SELECTION Final Report
Catherine W. McDonald, William Riddle, and Christine Youngblut Mar. 1985 66 p
(Contract MDA903-84-C-0031)
(AD-A163271; AD-E500744; IDA-P-1814-Vol-2; IDA/HQ-85-29622-Vol-2) Avail: NTIS HC A04/MF A01 CSCL 09/2

Initially, the Ada Joint Program Office (AJPO) sponsored Professors Peter Freeman and Anthony Wasserman to identify requirements for software development methodologies that would allow the Department of Defense (DoD) to realize the full potential of Ada. Since that time, the work on methodologies to support Ada has been transferred to the DoD Joint Program Office for the program entitled Software Technology for Adaptable and Reliable Systems (STARS). The STARS Joint Program Office (SJPO) objective is to improve the productivity level of software system development and support as well as the resulting quality of deployed software systems. This report consists of two volumes: Volume I presents the organization and plans of the STARS Methodology Coordination Team. Volume II is a technical report concerned with the development of methodology classification, evaluation and selection technologies and a framework of characteristics that can be used to support these technologies. GRA

N86-26938# Institute for Defense Analyses, Alexandria, Va.
USER'S MANUAL FOR THE PROTOTYPE ADA (TRADEMARK) COMPILER EVALUATION CAPABILITY (ACEC), VERSION 1 Final Report
Audrey A. Hook, Gregory A. Riccardi, Michael Vilot, and Stephen Welke Oct. 1985 69 p refs
(Contract MDA903-84-C-0031)
(AD-A163272; AD-E500741; IDA-P-1879; IDA/HQ-85-30428) Avail: NTIS HC A04/MF A01 CSCL 09/2

The purpose of the Prototype Ada Compiler Evaluation Capability (ACEC) is to provide users with 1) an organized suite of compiler performance tests, and 2) support software for executing these tests and collecting performance statistics. These performance tests were collected by the Ada Evaluation and Validation (E&V) Team from several sources. The test programs, which have been in the public domain for some time, have been organized as a test suite according to categories which are explained in Section II. The strategy for measuring test performance and obtaining differential statistics is described in Section III. Section IV describes the entire support software architecture, including machine-dependent modules. General instructions for executing the Prototype ACEC are provided in Section V. GRA

N86-26939# Institute for Defense Analyses, Alexandria, Va.
COMMERCIAL MARKET POTENTIALS FOR THE USE OF THE ADA (TRADEMARK) PROGRAMMING LANGUAGE Final Report
David Dikel, Audrey A. Hook, and Patricia L. Greene Aug. 1985 53 p
(Contract MDA903-84-C-0031)
(AD-A163273; AD-E500742; IDA-M-106; IDA/HQ-85-30205) Avail: NTIS HC A04/MF A01 CSCL 09/2

Research on the use of the ADA language in the commercial community is discussed. The formal interview process took place during a seven month period from October 1984 to April 1985. The objective of the study was to investigate and describe areas of commercial ADA use in an effort to encourage better informed investments in the development and implementation of ADA products by the commercial community. GRA

N86-26940# Defence Research Establishment Atlantic, Dartmouth (Nova Scotia).
CIRCE: A NATURAL LANGUAGE RULE TRANSLATION SYSTEM FOR INTERSENSOR
James R. Ellis and C. Ann Dent Nov. 1985 49 p
(AD-A163279; DREA-TC-85/314) Avail: NTIS HC A03/MF A01 CSCL 09/2

CIRCE is a set of functions written in LISP as an experiment in natural language processing. It was developed for knowledge acquisition by the Intersensor system, a sonar knowledge-based inference system. The main function of CIRCE inputs from either the keyboard or a file a rule written in English and converts it into a LISP-like data structure. This conversion takes place in two steps: the English text is first parsed, and then the relevant information is extracted from the resulting list and assembled into rules. These rules are then written to a file where they can be used directly by the inference mechanism of Intersensor without further processing. The paper briefly reviews prior research at DREA in this area, and contrasts the current system with its predecessors. Implementation problems are discussed, and suggestions for improvements are given. Author (GRA)

N86-26941# Naval Research Lab., Washington, D. C.
APPLICATION OF FLUX-CORRECTED TRANSPORT TO TTCP JOINT LAUNCH BLAST COMPUTATIONAL EFFORT
P. S. Kamath, S. Eidelman, M. A. Fry, J. D. Baum, and D. L. Book 31 Dec. 1985 135 p
(AD-A163332; NRL-MR-5701) Avail: NTIS HC A07/MF A01 CSCL 19/4

The method of Flux-Corrected Transport (FCT) was developed as a means for solving systems of hyperbolic equations in such a way that physically positive quantities like mass and energy density remain positive. Its principal application has been to compressible fluids, i.e., fluids in which some of the flow speeds are comparable with or greater than the local speed of propagation of waves in the medium. During the past decade the method has been extended and generalized in a number of important respects. A general-purpose FCT hydrocode was used to treat two muzzle blast test problems. Analysis of the results and comparison with data indicates that the results are physically realistic and, within the modeling assumptions, highly accurate. The FCT simulation model used runs on the Cray-1 and on smaller mainframe computers including the VAX and the multitasking array processors in our Graphical and Array Processing System. GRA

N86-26942# Softech, Inc., Fairborn, Ohio.
Ada (TRADEMARK) COMPILER VALIDATION SUMMARY REPORT. VERDIX Ada COMPILER, VADS, VERSION V03.06 FOR VAX-11/785, USING ULTRIX 1.0 Final Report, 14 Jun. 1985 - 14 Jun. 1986
14 Jun. 1985 46 p
(Contract F33600-84-D-0280)
(AD-A163345; Rept-3285-2-15.2) Avail: NTIS HC A03/MF A01 CSCL 09/2

This Validation Summary Report presents the results and conclusions of performing standardized tests on the Verdix Ada compiler (VADS). The VADS is hosted on the VAX-11/785 computer operating under ULTRIX 1.0. The suite of tests known as the Ada Compiler Validation Capability (ACVC), Version 1.5, was used. The ACVC suite of tests is used to validate conformance of the compiler to ANSI/MIL-STD-1815A (ADA). The purpose of

the testing is to ensure that the compiler properly implements legal language constructs and that it identifies, rejects from processing, and labels illegal language constructs. The testing also identifies implementation-dependent behavior permitted by the standard. Six classes of tests are used. These tests are designed to perform checks at compile time, during execution, and at link time. GRA

N86-26943# Softech, Inc., Fairborn, Ohio.
ADA (TRADE NAME) COMPILER VALIDATION SUMMARY REPORT: VERDIX ADA COMPILER, VADA-010-0101, VERSION V03.04 FOR VAX-11/750, USING UNIX 4.2 BSD Final Report, for 15 Mar. 1985 - 15 Mar. 1986
15 Mar. 1985 47 p refs
(Contract F33600-84-D-0280)
(AD-A163363) Avail: NTIS HC A03/MF A01 CSCL 09/2

The purpose of this Validation Summary Report is to present the results and conclusions of performing standardized tests on the Verdix Ada Compiler. The suite of tests known as the Ada Compiler Validation Capability (ACVC), Version 1.5, was used. The ACVC suite of tests is used to validate conformance of the compiler to ANSI/MIL-STD-1815A (ADA). The purpose of the testing is to ensure that the compiler properly implements legal language constructs and that it identifies, rejects from processing, and labels illegal language constructs. The testing also identifies implementation-dependent behavior permitted by the standard. Six classes of tests are used. These tests are designed to perform checks at compile time, during execution, and at link time. GRA

N86-26944# Ballistic Research Labs., Aberdeen Proving Ground, Md.
A NONPARAMETRIC STATISTICAL APPROACH TO THE VALIDATION OF COMPUTER SIMULATION MODELS
William E. Baker and Malcolm S. Taylor Nov. 1985 38 p
(AD-A163376; BRL-TR-2696) Avail: NTIS HC A03/MF A01 CSCL 09/2

Initially the authors completed a literature search in order to identify existing methods of computer simulation validation. Nonparametric statistical techniques were subsequently adapted to both deterministic and stochastic simulations, and these procedures were applied to a computer model currently in use at the Ballistic Research Laboratory. Monte-Carlo methods provided an indication of the power of these tests, and a mention of future work concerning attempts to increase this power has been included in this report. Author (GRA)

N86-26945# Massachusetts Inst. of Tech., Cambridge.
SPACE-EFFICIENT ALGORITHMS FOR COMPUTATIONAL GEOMETRY M.S. Thesis
Cynthia A. Phillips Oct. 1985 34 p
(Contract N00014-80-C-0622)
(AD-A163426) Avail: NTIS HC A03/MF A01 CSCL 09/2

For the VLSI design to be reliably produced as a working chip, various features on the chip must be separated by minimum distances to ensure the proper operation of transistors and interconnections. The design rule checker program verifies that these and other geometric constraints are satisfied and signals an error if it finds two features that violate the design rules. For a chip composed of millions of rectangles, design rule checking is a time-consuming process which cannot be done entirely within the primary memory of many computers. This thesis presents an efficient algorithm for finding the connected components of rectangles in the plane using a machine model incorporating the secondary disk memory where the VLSI design is stored. By running this algorithm simultaneously on each layer of a VLSI chip design, a design rule checker can determine which features of a chip design are electrically equivalent, i.e., are effectively part of the same wire. The determination of electrical equivalence allows the design rule checker to avoid reporting the many aliasing errors which occur when two electrically equivalent features are mistaken for electrically distinct features. For example, two wires might be too close together, but if they are actually the same wire, it does not matter. GRA

N86-26946# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
SCHEMA: AN ARCHITECTURE FOR KNOWLEDGE BASED CAD
C. G. Clark and R. E. Zippel Oct. 1985 4 p
(Contract N00014-80-C-0622)
(AD-A163437) Avail: NTIS HC A02/MF A01 CSCL 09/2

Schema provides an integrated environment for all aspects of the synthesis and analysis of electronic designs from PC boards through circuit and mask design of VLSI devices. It simplifies the development of synthesis and analysis tools by using uniform data structures and by making available libraries of standard routines and advanced control structures appropriate for CAD tool development. Because all tools in the Schema environment utilize the same abstract data structures it is easy for tools to interchange data about a design or even pieces of the design itself. Schema also permits much of the design to be done in a technology independent fashion by allowing the designer to delay implementation decisions until the last possible moment. The information associated with a particular component of a design is organized as a module. Modules contain schematics, icons, topologies, layouts, simulation results, and other descriptive information for this component. The descriptions contained in modules are implemented as procedures which utilize other modules in a hierarchical fashion. Author (GRA)

N86-26947# Naval Postgraduate School, Monterey, Calif.
USE OF COLOR IN DIFFERENTIATING FACTOR LEVELS IN SIMULATION OUTPUT (PRELIMINARY REPORT)
Peter A. W. Lewis Jan. 1986 13 p
(AD-A164651; NPS55-86-001) Avail: NTIS HC A02/MF A01 CSCL 09/2

A simulation is essentially a multi-factor statistical sampling experiment through which approximate answers to questions about some aspect of a system or statistic are obtained. Unfortunately the multi-factor aspect of the simulation is usually downplayed because of the difficulties of organizing and displaying the output as a function of various factors. Some graphical procedures using color are suggested for assessing the effect of the factors on the output. This is done in the context of an example of a multiserver queue. Classical analysis of variance techniques are usually not appropriate for this analysis because the data is non-normal and the mean is seldom an adequate or complete characterization of the output. GRA

N86-26948# Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.
VERIFYING TEMPORAL PROPERTIES WITHOUT USING TEMPORAL LOGIC
Bowen Alpern and Fred B. Schneider Dec. 1985 43 p
(Contract N00014-86-K-0092; Grant NSF DCR-83-20274)
(AD-A164820; CU-CSD-TR-85-723) Avail: NTIS HC A03/MF A01 CSCL 09/2

A new approach for proving temporal properties of concurrent programs is presented. The approach does not use temporal logic. To show that a program satisfies a given temporal property, the property is first decomposed into proof obligations. These obligations are then discharged by devising suitable invariant assertions and variant functions for the program. The approach is quite general - it handles a superset of the properties that can be expressed in linear-time temporal logic. Author (GRA)

N86-26949# Naval Postgraduate School, Monterey, Calif.
TOP-DOWN PARSING SYNTAX ERROR RECOVERY M.S. Thesis
Paul E. Hallowell, Jr. Dec. 1985 179 p
(AD-A164859) Avail: NTIS HC A09/MF A01 CSCL 09/2

Compiler writers continue to search for a reliable method of syntactic error recovery. Spurious error reports and confusing diagnostics are common problems confronting the programmer.

Innumerable error possibilities have made recovery design a frustrating task. This thesis implements a method of syntactic error recovery using recursive calls on the error recovery routine. Parsing is accomplished by traversing transition diagrams which are created from syntax charts. Key language symbols and dynamically generated recovery positions are used in restoring the parse. High-quality error diagnostics give a clear, accurate, and thorough description of each error, providing an excellent instuctional software tool. Approach and implementation issues are discussed, and sample output listings are included. Author (GRA)

N86-26950# Naval Postgraduate School, Monterey, Calif.
SURFACE CONSTRUCTION FROM PLANAR CONTOURS M.S, Thesis
Patrick G. Hogan Dec. 1985 62 p
(AD-A164862) Avail: NTIS HC A04/MF A01 CSCL 09/2

Many scientific and technical endeavors require the reconstruction of a three-dimensional solid from a collection of two-dimensonal contours. One method for this reconstruction involves a procedure whereby individual pairs of contours are mapped together to form triangular surface patches. This thesis presents an algorithm which not only handles mapping situations of simple, closed contours but also mappings of multiple/contours per plane and partial contour mappings. Also included is a discussion of algorithm limitations and heuristics. Author (GRA)

N86-26951# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
SEMI-APPLICATIVE PROGRAMMING. EXAMPLES OF CONTEXT FREE RECOGNIZERS
N. S. Sridharan Jan. 1986 47 p refs
(Contracts N00014-77-C-0378; N00014-85-C-0079)
(AD-A164897; BBN-6135) Avail: NTIS HC A03/MF A01 CSCL 09/2

Most current parallel programming languages are designed with a sequential programming language as the base language and have added constructs that allow parallel execution. We are experimenting with an applicative base language that has implicit parallelism everywhere, and then we introduce constructs that inhibit parallelism. The base language uses pure LISP as a foundation and blends in interesting features of Prolog and FP. Proper utilization of available machine resources is a crucial concern of programmers. We advocate several techniques of controlling the behavior of functional programs without changing their meaning or functionality: program annotation with constructs that have benign side-effects, program transformation and adaptive scheduling. This combination yields us a semi-applicative programming language and an interesting programming methodology. This paper deals with context-free parsing as an illustration of semi-applicative programming. Starting with the specification of a context-free recognizer, we have been successful in deriving variants of the recognition algorithm of Cocke-Kasami-Younger. GRA

N86-26952# Army Electronic Proving Ground, Fort Huachuca, Ariz.
METHODOLOGY INVESTIGATION: MULTILINGUAL STATIC ANALYSIS TOOL (MSAT) Final Report
Edward L. Anderson Nov. 1985 81 p
(AD-A164956) Avail: NTIS HC A05/MF A01 CSCL 09/2

The Multilingual Static Analysis Tool (MSAT) investigation was conducted to develop a software tool to automate the collection and reporting of software design and quality characteristics in a multilingual milieu. The goal of MSAT is to minimize the manual effort associated with the static software assessment of a target software system's design, structure, maintainability, modifications, and conformance with documented design and development standards. MSAT consists of a flexible, language-independent data collection component which extracts and stores items of interest in a DBMS; static analysis/report generation components for calculating and presenting software metrics and reports; and an executive control component which provides a user-friendly interface. Author (GRA)

N86-26953# Georgia Inst. of Tech., Atlanta. School of Information and Computer Science.
SOFTWARE TEST AND EVALUATION MANUAL. VOLUME 1: GUIDELINES FOR THE TREATMENT OF SOFTWARE IN TEST AND EVALUATION MASTER PLANS Final Report
Oct. 1985 71 p
(Contracts DAAH01-85-D-A005; F33657-82-G-2083)
(AD-A165208; GIT-ICS-85/26-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 09/2

The Software Test and Evaluation Manual provides guidance to DoD components in the area of software test and evaluation for defense system acquisition. It was prepared by the Software Test and Evaluation Project (STEP) in response to tasking by the Director Defense Test and Evaluation (OSD/USDR&E). Volume I is intended to support the review of Test and Evaluation Master Plans (TEMPs) for systems that contain mission critical software components, are software intensive, or present software testing issues that significantly affect risk. It consists of a checklist or series of questions that are keyed to the major paragraphs of a TEMP, and an accompanying set of explanatory notes that are brief commentaries on the questions and the significance of the possible responses to them. The primary audience for this manual consists of those individuals who are responsible for evaluating TEMPs. However, it should also prove useful to program offices, independent test organizations, contractors, and others who review, prepare, or provide data for inclusion in TEMPs. GRA

N86-26954# Softech, Inc., Waltham, Mass.
Ada (TRADEMARK) TRAINING CURRICULUM. SOFTWARE ENGINEERING METHODOLOGIES m201 TEACHER'S WORK-BOOK
1986 160 p
(Contract DAAB07-83-C-K506)
(AD-A165299; AD-E301922) Avail: NTIS HC A08/MF A01 CSCL 05/9

Each Exercise of the Ada training curriculum has the following format: (1) Overview of the method, (2) Problem statement; (3) Solution method; (4) Syntax summary; and (5) Pages for documenting the solution. GRA

N86-26955# Softech, Inc., Waltham, Mass.
Ada (TRADEMARK) TRAINING CURRICULUM. SOFTWARE ENGINEERING METHODOLOGIES m201 TEACHER'S GUIDE, VOLUME 1
1986 456 p
(Contract DAAB07-83-C-K506)
(AD-A165300; AD-E301922) Avail: NTIS HC A20/MF A01 CSCL 05/9

The contents of the Ada training curriculum are as follows: (1) introduction -- course goals; (2) software engineering (SE); (3) the software life cycle; (4) software engineering methodologies; (5) analysis introduction; (6) SADT methodology; (7) SREM methodology; (8) entity diagramming; (9) PSL/PSA; (10) structured systems analysis methods; (11) software cost reduction project (SCRP) methodology; (12) analysis wrap-up; (13) design introduction; (14) software cost reduction project(SCRP) design methods; (15) object-oriented design; (16) structured design methodology; (17) Jackson methodology; (18) Warnier-Orr methods; (19) higher order software (HOS) method; (20) architectural design metrics; (21) program design languages (PDL); (22) graphical detailed design methods; (23) design wrap-up; (24) implementation introduction; (25) structured programming; (26) program complexity management; (27) program correctness; (28) testing approaches; (29) methods of review; (30) implementation wrap-up; and (31) course wrap-up. GRA

N86-26956# Softech, Inc., Waltham, Mass.
Ada (TRADEMARK) TRAINING CURRICULUM. SOFTWARE ENGINEERING METHODOLOGIES m201 TEACHER'S GUIDE, VOLUME 2
1986 503 p
(Contract DAAB07-83-C-K506)
(AD-A165301; AD-E301922) Avail: NTIS HC A22/MF A01 CSCL

05/9

This Ada training curriculum teacher's guide on software engineering methodologies consists of the following sections: (1) software cost reduction project (SCRP) methodology; (2) analysis wrap-up; (3) design introduction; (4) software cost reduction project design methods; (5) object-oriented design; (6) structured design methodology; (7) Jackson methodology; (8) Warnier-Orr method; (9) higher order software method; and (10) architectural design metrics. GRA

N86-26957# Softech, Inc., Waltham, Mass.
Ada (TRADEMARK) TRAINING CURRICULUM. SOFTWARE ENGINEERING METHODOLOGIES m201 TEACHER'S GUIDE, VOLUME 3
1986 393 p
(Contract DAAB07-83-C-K506)
(AD-A165302; AD-E301922) Avail: NTIS HC A17/MF A01 CSCL 05/9

This Ada training curriculum teacher's guide on Software Engineering Methodologies consists of the following sections: (1) program design languages; (2) graphical detailed design methodsHIPO tool and NSSF tool; (3) design wrap-up; (4) implementation introduction; (5) structured programming; (6) program complexity management; (7) program correctness; (8) testing approaches; (9) methods of review; (10) implementation wrap-up; and (11) instructor notes. GRA

N86-26958# Softech, Inc., Waltham, Mass.
Ada (TRADEMARK) TRAINING CURRICULUM. Ada (REGISTERED TRADEMARK) FOR SOFTWARE MANAGERS, 1201: TEACHER'S GUIDE, VOLUME 1
1986 405 p
(Contract DAAB07-83-C-K506)
(AD-A165314; AD-E301922) Avail: NTIS HC A18/MF A01 CSCL 05/9

The Ada training curriculum teacher's guide for software managers consists of the following sections: (1) introduction; (2) lexical rules; (3) data types; (4) statements; (5) packages and private types; and (6) subprograms. GRA

N86-26959# Softech, Inc., Waltham, Mass.
ADA (TRADEMARK) TRAINING CURRICULUM. ADA (REGISTERED TRADEMARK) FOR SOFTWARE MANAGERS, L201. VOLUME 2: TEACHER'S GUIDE
1986 388 p Supersedes report dated May 1984, AD-A142431
(Contract DAAB07-83-C-K506)
(AD-A165315; AD-E301922) Avail: NTIS HC A17/MF A01 CSCL 05/9

This teacher's guide on Ada for Software managers consists of the following sections: (1) Tasks; (2) Generics; (3) Input/output (4) Exceptions; (5) Stubbing; (6) Visibility and scope; (7) Overloading; (8) Pragmas; and (9) Low-level features. Other sections presented are: (10) Summary of uses of Ada features; (11) Introduction to Ada design/code assessment; (12) Characteristics of good Ada designs; and (13) Ada in perspective; reusability and portability. GRA

N86-26960# Maryland Univ., College Park. Dept. of Computer Science.
CHARACTERIZATION OF AN Ada SOFTWARE DEVELOPMENT
Victor R. Basili, Elizabeth E. Katz, Nora M. Panlilio-Yap, Connie L. Ramsey, and Shih Chang Sep. 1985 13 p Previously announced in IAA as A85-48023
(Contract N00014-82-K-0225)
(AD-A165320) Avail: NTIS HC A02/MF A01 CSCL 05/9

This article examines the use of Ada in a software project developed by the General Electric Company. The project was monitored by the University of Maryland and GE to identify areas of success and difficulty in learning and using Ada as both a design and a coding language. Since production-quality Ada translators were not readily available, the study focused on training and early software development. Our study also presents the major factors to consider before using Ada in software development, particularly when training in Ada is necessary. Our study attempts to meet several goals. The first focuses on characterization of the effort, the changes, and the errors of the project. The second considers how Ada was used on the project. The third concerns evaluation of the data collection and validation process, while the fourth concentrates on the development of measures for the Ada Programming Support Environment. GRA

N86-26961# Maryland Univ., College Park.
SOFTWARE METRICS FOR Ada Final Report
Victor R. Basili 3 Feb. 1986 4 p
(Contract N00014-82-K-0225)
(AD-A165321) Avail: NTIS HC A02/MF A01 CSCL 09/2

The investigators monitored a software development project written in Ada by integrating measurement into the software development process. Their goal is to identify areas of success and difficulty in learning and using Ada as a design and coding language. The underlying process and the evolving product are measured, and the resulting information characterizes this project's successes and failures. It may be used to make recommendations about training, methodology, and metrics to the Ada users community. This experience with data collection and metrics will aid in the selection of a general set of measures and measurement procedures for any software development project. The project studied involved the redesign and reimplementation, at the General Electric Company, of a portion of a satellite ground control system originally written in FORTRAN. GRA

N86-26962# Maryland Univ., College Park. Dept. of Computer Science.
MONITORING AND Ada SOFTWARE DEVELOPMENT PROJECT
Victor Basili, John Gannon, Elizabeth Katz, Marvin Zelkowitz, and John Bailey 1986 4 p
(Contract N00014-82-K-0225)
(AD-A165324) Avail: NTIS HC A02/MF A01 CSCL 09/2

As any science matures, the role of measurement, analysis and experimentation grows. The software engineering community has seen the continued development of new software development methods and tools and their use in various environments. The evaluation of methods and tools began with subjective criteria and has been developing toward more objective data collection, measurement and controlled experiments. While this trend is encouraging, these evaluation studies have largely been on a one-shot basis. What has been missing is a systematic approach which defines a longe-range program for the study, analysis and evaluation of a specific method or tool. The emergence of Ada provides a focal point for developing such a systematic study. As a first step, research teams from the University of Maryland and General Electric have embarked upon an eighteen-month collaborative effort. The purpose of this effort is to monitor the use of Ada on a realistically large and complex software development project within industry. GRA

N86-26963# Maryland Univ., College Park. Dept. of Computer Science.
METRICS FOR Ada PACKAGES: AN INITIAL STUDY
J. D. Gannon, E. E. Katz, and V. R. Basili 1985 16 p
(Contract N00014-82-K-0225)
(AD-A165336) Avail: NTIS HC A02/MF A01 CSCL 09/2

Many novel features of Ada (e.g., packages, generics, tasking, and exception handling) were included in the language to improve readability, aid modification, or encourage reusability. Since they have not been available in other widely used languages, packages present programmers with a fairly formidable learning task. We studied four first-time Ada programmers as they developed a ground-support satellite system. Metrics are presented which characterize their use of Ada packages, indicating where program structure may make changes difficult, and suggesting how the structure may be improved. The findings suggest that a good background in the software engineering practices supported by Ada is necessary to learn to use the features of the language --

simply teaching professional programmers Ada is not enough. GRA

N86-26964# Softech, Inc., Waltham, Mass.
Ada (TRADEMARK) PRIMER
1986 381 p Supersedes AD-A148855
(Contract DAAB07-83-C-K506)
(AD-A165345) Avail: NTIS HC A17/MF A01 CSCL 09/2

Ada is a high order language (HOL) developed by the Department of Defense (DoD) to be used in programming embedded systems. It is anticipated that use of Ada will significantly reduce the costs associated with defense software by providing more maintainable code. One of the goals of this workbook is to illustrate how to use the features of the Ada language to help produce more maintainable code. Ada Primer is the first of a series of three workbooks. The other two workbooks are entitled respectively, Advanced Ada and Real-Time Ada. Ada Primer leads the novice through the fundamentals of Ada by addressing the so-called Pascal subset of Ada. This workbook may be used in conjunction with module L202, Basic Ada Programming. A student, having completed L202 in conjunction with this workbook, shall be able to use an Ada package and code Ada subprograms using the Pascal subset of Ada. With the exception of Section 1 of this workbook, each workbook is organized as a series of Ada exercises to be solved by the reader. Taken sequentially as presented in the workbook, the exercises expose the student to the features of Ada in a logical fashion. In order to gain full benefit from this workbook, it is strongly recommended that the exercises be completed in the order presented. The solution to a specific exercise is located directly following the exercise. GRA

N86-26965# Softech, Inc., Waltham, Mass.
Ada (TRADEMARK) TRAINING CURRICULUM. INSTRUCTOR'S COURSE s500 MANAGEMENT MODULES
1986 129 p
(Contract DAAB07-85-C-K506)
(AD-A165347) Avail: NTIS HC A07/MF A01 CSCL 05/9

This Instructor's Course Consists of the following Sections: (1) Overview; (2) Ada orientation for managers; (3) Software engineering for managers; (4) Ada for software managers; and (5) Real time concepts. An overall picture is given, details are presented in other volumes. GRA

N86-26966# Softech, Inc., Waltham, Mass.
Ada (TRADEMARK) TRAINING CURRICULUM. INSTRUCTOR'S COURSE s500 INTRODUCTORY LANGUAGE MODULES
1986 83 p
(Contract DAAB07-85-C-K506)
(AD-A165348) Avail: NTIS HC A05/MF A01 CSCL 05/9

This instructor's course consists of the following sections: (1) Overview; (2) Ada technical overview; (3) Introduction to Ada - A higher order language; and (4) Basic Ada programming. GRA

N86-26967# Softech, Inc., Waltham, Mass.
Ada (TRADEMARK) TRAINING CURRICULUM. INSTRUCTOR'S COURSE s500 METHODOLOGY MODULES
1986 234 p
(Contract DAAB07-85-C-K506)
(AD-A165349) Avail: NTIS HC A11/MF A01 CSCL 05/9

This instructor's course consists of the following sections: (1) Overview; (2) Introduction to software engineering; (3) Software engineering methodologies; and (4) Programming methodology. GRA

N86-26968# Softech, Inc., Waltham, Mass.
Ada (TRADEMARK) TRAINING CURRICULUM. INSTRUCTOR'S COURSE s500 OVERVIEW
1986 108 p
(Contract DAAB07-85-C-K506)
(AD-A165350) Avail: NTIS HC A06/MF A01 CSCL 05/9

This instructor's course consists of the following sections: (1) Philosophy Behind the Curriculum; (2) Overview of the Curriculum; and (3) General considerations. GRA

N86-26969# Softech, Inc., Waltham, Mass.
Ada (TRADEMARK) TRAINING CURRICULUM: Ada ORIENTATION FOR MANAGERS 1101 TEACHER'S GUIDE
1986 249 p Supersedes AD-A141846
(Contract DAAB07-83-C-K514)
(AD-A165351) Avail: NTIS HC A11/MF A01 CSCL 05/9

This teacher's guide consists of the following sections: (1) Why Ada?; (2) What Ada is Not; (3) What Ada is; (4) What are some transition issues with Ada; and (5) Where is Ada now and tomorrow. The historical motivation for Ada is set. GRA

N86-26970# Softech, Inc., Waltham, Mass.
Ada (TRADEMARK) TRAINING CURRICULUM: Ada TECHNICAL OVERVIEW 1102 TEACHER'S GUIDE
1986 211 p Supersedes AD-A141862
(Contract DAAB07-83-C-K506)
(AD-A165352) Avail: NTIS HC A10/MF A01 CSCL 05/9

This teacher's guide on Ada Technical overview consists of the following sections: (1) background and rationale for Ada; (2) writing an Ada program from begin to end; (3) summary of Ada program structure; (4) Ada through example; (5) large system development; (6) summary of Ada features. Instructions are given for the student who wishes more information. GRA

N86-26971# Army Electronic Proving Ground, Fort Huachuca, Ariz.
SOFTWARE TESTING OF MULTIPROCESSOR SYSTEMS Final Methodology Investigation Report
Edward L. Anderson Oct. 1985 68 p
(AD-A165387) Avail: NTIS HC A04/MF A01 CSCL 09/2

The increasing complexity of battlefield automated systems (BAS) has dictated the need to use multiple processors to enhance system reliability and to provide timely processing in systems that process large volumes of data. One such system, Position Location Reporting System (PLRS), has completed developmental testing; several more (Remotely Piloted Vehicle (RPV), Facility Intrusion Detection System (FIDS), and All Source Analysis System (ASAS)) are in the development phase. Additionally, the trend is toward distributive processing systems which will have multiple interactive processors and common software functions. Very little has been done to establish comprehensive test procedures for evaluating these systems, particularly under full load conditions. The objective of this investigation was to establish methods and procedures for evaluation of software for systems containing multiple interactive processors. A number of multiprocessor monitors/debuggers were examined for function and design approach. The investigation resulted in the development of a hybrid monitor concept: the integration of both hardware and software monitor capabilities into a central monitor system. This phase of the investigation resulted in revision of the specification documents and continued design and implementation of the prototype hybrid monitor. GRA

N86-26972# Naval Postgraduate School, Monterey, Calif.
IMPLEMENTATION OF A NATURAL LANGUAGE PROCESSOR USING FUNCTIONAL GRAMMAR M.S. Thesis
Fred G. Orchard Dec. 1985 81 p
(AD-A165428) Avail: NTIS HC A05/MF A01 CSCL 09/2

This thesis presents the design and implementation of a natural language processor using Functional Grammar. Traditionally, grammars have consisted of a set of words and a set of semantic and syntactic rules which combine the words to form sentences. Thus, the language is looked at as a syntactic structure which is used to derive meaning. Functional Grammar looks at language as a means of social interaction and applies the syntactic and semantic rules only after the meaning, based on pragmatics, of the sentence has been established. Prolog has been used to demonstrate how Functional Grammar can be used to provide that meaning. GRA

N86-26973# M/A-COM Linkabit, Inc., Vienna, Va.
SOFTWARE DOCUMENTATION ON THE URDB MODIFICATIONS TO INCORPORATE INFORMATION COLLECTED IN

POST-DSCS AND UHF STUDIES Final Report, 15 Jul. - 14 Oct. 1985
S. Keyser and D. Eversmeyer 15 Oct. 1985 10 p refs
(Contract DCA100-84-C-0009)
(AD-A165451; Rept-159; DCA/MSO-85-129) Avail: NTIS HC A02/MF A01 CSCL 09/2

This documentation has been produced to provide system managers and programmers with the information necessary to understand the URDB modifications to incorporate information collected in the Post-DSCS and UHF studies. This document is intended to be used as a supplement to the MILSATCOM User Requirements System (MURS) URDB Program Maintenance Manual (November 1984), which defines other MURS software that is used in this system. GRA

N86-26974# Analytics, Inc., Willow Grove, Pa.
DESIGN METHODOLOGY FOR EMBEDDED SYSTEMS Final Report
David Lefkovitz 15 Nov. 1985 140 p
(Contract N62269-80-D-0025)
(AD-A165497; TR-1500.21) Avail: NTIS HC A07/MF A01 CSCL 09/2

This contract has explored the multidimensional problem of the development of embedded software systems. In its reports and presentations the work has characterized these problems in various ways, but to view them as multidimensional is helpful inasmuch as the problems may be separated into different solution domains. These have been identified as: communication; principles and practices; technology, and compiler (Ada) language structure and capability. Its contents are as follows: The Domain of Solutions; Integration of the Four Solution Domains; Tools; Program Architectural Designs; The Embedded Software Design Simulator (ESDS). GRA

N86-26975# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Datenverarbeitung in der Technik.
A THEORY OF PARTIAL SYSTEMS
F. J. Polster Oct. 1985 116 p
(KfK-3982; ISSN-0303-4003; ESA-86-96911) Avail: NTIS HC A06/MF A01

The notion of fragment system is introduced as a formalization of the properties of interconnections among fragments of code used to implement parts of a computer program. It is a model for system families, where the members of a system family (the partial systems) are composed of a subset of a collection of shared system components (the fragments). An algorithm for the construction of a characteristic set CF is presented: CF is a minimal subset of fragments with the property, that it is sufficient to indicate for the fragments of CF only, whether or not they are relevant for a partial system. An explicit representation of the set of partial system is developed as a subset of (0,1) [CF], the elements of which satisfy Boolean expressions, called restrictions. Restrictions are inherent to the fragment system and can be algorithmically derived. Restrictions may also be employed to model semantics of the system interface. ESA

N86-26976# Karlsruhe Univ. (West Germany). Fakultaet fuer Informatik.
COMPUTER AIDED MANUFACTURING (CAM) DATA BASES: REQUIREMENTS AND SURVEY
Alfons Kemper Aug. 1985 18 p refs
(Rept-17/85; ESA-86-96930) Avail: NTIS HC A02/MF A01

The most common representation schemes for modeling solid geometric objects in a computer, including the constructive solid geometry model and the boundary representation model are investigated from a data structure point of view, i.e., investigating the requirements which such schemes impose on a database management system. Developments in engineering databases with regard to supporting these representation schemes are discussed. Systems considered are extensions to the relational data model. The investigation is carried out by defining the (skeleton) schemes for the representation methods in the particular data base management system. ESA

N86-26977# Center for Mathematics and Computer Science, Amsterdam (Netherlands).
OPERATIONAL SEMANTICS OF A PARALLEL OBJECT-ORIENTED LANGUAGE
Pierre America (Philips Gloeilampenfabrieken N. V., Eindhoven, Netherlands), Jaco deBakker, Joost N. Kok, and Jan Rutten Aug. 1985 22 p Revised Sponsored by European Economic Commission Esprit Project 415
(CWI-CS-R8515; B8575492; ESA-86-97006; ISSN-0167-8590) Avail: NTIS HC A02/MF A01

The semantics of the programming language POOL is described. The language integrates the object-oriented structure of languages like Smalltalk-80 with facilities for concurrency and communication like the ones in Ada. The semantics is described in an operational way: it is based on transition systems. By using a way of representing parallel processes that is different from the traditional one, it is possible to overcome difficulties pertaining to the latter. The resulting semantics shows a close resemblance with the informal language description, and there are good prospects that it can serve as a secure guide for the implementation of the language. ESA

N86-26978# Center for Mathematics and Computer Science, Amsterdam (Netherlands).
A CONCEPTUAL MODELING EXPERT SYSTEM
M. L. Kersten, H. Weigand (Vrije Universiteit, Amsterdam, Netherlands), F. Dignum, and J. Boom Sep. 1985 17 p Revised
(CWI-CS-R8518; B8575499; ESA-86-97009) Avail: NTIS HC A02/MF A01

The architecture of an interactive conceptual modeling expert system, called ACME is described. The input to ACME is a natural language description of the application domain, decomposed by a parser into so-called predications. From these predications a preliminary EAR model can be extracted readily, which is subsequently improved by the EAR modeling expert using structural and semantic rules stored in a knowledge base. In an iterative process the user resolves the inconsistency and ambiguity problems discovered by ACME and enhances the conceptual model. ESA

N86-26979# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science/ Algorithmics and Architecture.
TAPE VERSUS QUEUE AND STACKS: THE LOWER BOUNDS
Ming Li (Cornell Univ., Ithaca, N.Y.) and Paul M. B. Vitanyi Sep. 1985 27 p refs Supersedes Rept-TR-84-591; CWI-CS-R8406 Submitted for publication
(Grant NSF DCR-83-01766)
(CWI-CS-R8519; Rept-TR-84-591; CWI-CS-R8406; B8575495; ESA-86-97010) Avail: NTIS HC A03/MF A01

Optimal or nearly optimal lower bounds on the time needed to simulate queue, stacks (stack = pushdown store) and tapes by one off-line single-head tape-unit with one-way input, both deterministic and nondeterministic are derived. The techniques rely on algorithmic information theory (Kolmogorov complexity). ESA

N86-26980# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
PROGRAM DERIVATION THROUGH TRANSFORMATIONS: THE EVOLUTION OF LIST-COPYING ALGORITHMS
N. W. P. vanDiepen and W. P. deRoever (Technische Hogeschool, Eindhoven, Netherlands) Sep. 1985 63 p Revised Submitted for publication
(CWI-CS-R8520-Rev; RUU-CS-85-3; B8575496; ESA-86-97011) Avail: NTIS HC A04/MF A01

The technique of program transformation is used to show the derivability and to prove the correctness of fast list-copying algorithms developed by Robson, Fisher and Clark. Transformation rules necessary for the correctness proofs are given. Other proof techniques used include data refinement and the use of auxiliary variables and structures. ESA

N86-26981# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
AN OPERATIONAL SEMANTICS FOR PROCESS ALGEBRA
J. C. Baeten, J. A. Bergstra (Amsterdam Univ., Netherlands), and J. W. Klop Sep. 1985 33 p Revised report of RUU-CS-85-3 Submitted for publication Sponsored in part by European Economic Commission ESPRIT Project 432
(CWI-CS-R8522; B8575497; ESA-86-97013) Avail: NTIS HC A03/MF A01

Operational rewrite rules, expressing the dynamic behavior of configurations of objects are considered. This gives an algebraic way to generalize Petri net theory. Operational rewrite rules for process algebras are described, and it is shown that in each case the operational semantics thus obtained is equivalent to the regular denotational semantics of processes. This theory can be used to describe features like true concurrency and real-time behavior for concurrent, communicating processes. ESA

62 COMPUTER SYSTEMS

Includes computer networks.

N86-26982# Range Commanders Council, White Sands Missile Range, N. Mex. Data Reduction and Computing Group.
IRIG STANDARD DATA FORMAT FOR INTERRANGE TRANSMISSION OF TRACKING DATA FROM COMPUTER TO COMPUTER (2400 BPS SYNCHRONOUS EFG FORMAT 0)
Nov. 1985 12 p
(AD-A163251; DR/CG-161-85) Avail: NTIS HC A02/MF A01 CSCL 09/2

This document defines a standard format for interrange transmission of tracking data from a computer on one range to a computer on another range. GRA

N86-26983# Naval Postgraduate School, Monterey, Calif.
PRINTER MULTIPLEXING AMONG MULTIPLE Z-100 MICROCOMPUTERS M.S. Thesis
Kwang J. Choi and Ju K. Lee Dec. 1985 79 p
(AD-A165179) Avail: NTIS HC A05/MF A01 CSCL 09/2

This thesis describes the detailed design and implementation of a printer server in the laboratory environment of sharing resources among multiple Zenith Z-100 microcomputers. The Printer Server System is a controller box which consists of a power supply, a single board computer, and the BLC 8538 eight channel I/O expansion boards. Each Z-100 microcomputer is connected to the controller thru the RS-232C port. The Printer Server System has three software utilities: BOOT, CONTROL, and SPOOL. The BOOT process, resident in the controller, downloads the CONTROL file from any one of multiple Z-100's which is turned on. The CONTROL process allows the printer to be used by any one of multiple Z-100's at a time. The SPOOL process sends the data thru the CONTROL process to the printer or saves the data on the disk file. Author (GRA)

N86-26984# Pennsylvania State Univ., University Park.
RESEARCH IN DISTRIBUTED AND PARALLEL SYSTEMS Final Report, 1 May 1982 - 31 Dec. 1985
Joseph JaJa and Janos Simon 27 Feb. 1986 13 p
(Contract DAAG29-82-K-0110)
(AD-A165486; ARO-18896.30-EL) Avail: NTIS HC A02/MF A01 CSCL 09/2

The main research achievements in distributed and parallel systems have been in the following areas: Theory of communication complexity, lower bounds for VLSI computations, algorithms and special - purpose architectures for VLSI, theory of computation, CAD tools, parallel computation and fault-tolerant distributed computation. Author (GRA)

N86-26985# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science/ Algorithmics and Architecture.
DISTRIBUTED MATCHMAKING FOR PROCESSES IN COMPUTER NETWORKS
Sape J. Mullender and Paul M. B. Vitanyi Aug. 1985 25 p Presented at 4th ACM SIGACT-SIGOPS Symposium on Principles of Distributed Computing, Minaki, Ontario, 5-7 Aug. 1985 Revised
(CWI-CS-R8513; B8575501; ESA-86-97004) Avail: NTIS HC A02/MF A01

The problem of setting up communication when needed between processes in a multiprocessor network where processes have names but no permanent addresses is investigated. Establishing communication between a process asking for a service and a process giving that service, without centralized control in a distributed environment with mobile processes, constitutes the problem of distributed matchmaking. Logically, such a matchmaking phase precedes routing in store-and-forward computer networks of this type. Algorithms for distributed matchmaking are developed and their complexity is investigated in terms of message passes and storage needed. The theoretical limitations of distributed match-making are established and the techniques are applied to network topologies. ESA

63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support.*

N86-26986# Massachusetts Inst. of Tech., Cambridge.
ANALYSIS OF A MULTIACCESS CONTROL SCHEME
John N. Tsitsiklis Feb. 1986 10 p
(Contracts DAAG29-84-K-0005; N00014-77-C-0532)
(AD-A165498; LIDS-P-1534; ARO-20980.42-MA) Avail: NTIS HC A02/MF A01 CSCL 17/2

The usual slotted ALOHA model, under the infinite source assumption and ternary feedback is considered. In more detail, there is an infinite number of stations and, at the beginning of any time slot, each station may have at most one packet to transmit. Any station with an available packet may decide to attempt transmission (possibly using a probabilistic rule) or to decide to defer this attempt for later. The objective is to find a probabilistic rule that lets each station decide at any given time, using only the information available to it, whether it will transmit or not (of course this rule will be used only by those stations that have an available packet.) GRA

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N86-26987*# Lehigh Univ., Bethlehem, Pa.
ON THE SOLUTION OF INTEGRAL EQUATIONS WITH A GENERALIZED CAUCHY KERNEL
A. C. Kaya and F. Erdogan Mar. 1986 22 p refs
(Grants NGR-39-007-011; NSF MEA-84-14477)
(NASA-CR-176685; NAS 1.26:176685) Avail: NTIS HC A02/MF A01 CSCL 12A

In this paper a certain class of singular integral equations that may arise from the mixed boundary value problems in nonhomogeneous materials is considered. The distinguishing feature of these equations is that in addition to the Cauchy singularity, the kernels contain terms that are singular only at the end points. In the form of the singular integral equations adopted, the density function is a potential or a displacement and consequently the kernel has strong singularities of the form (t-x) sup-2, x sup n-2 (t+x) sup n, (n > or = 2, 0<x,t>b). The complex function theory is used to determine the fundamental function of the problem for the general case and a simple numerical technique is described to solve the integral equation. Two examples from the theory of elasticity are then considered to show the application of the technique. Author

N86-26988*# Lehigh Univ., Bethlehem, Pa.
ON THE SOLUTION OF INTEGRAL EQUATIONS WITH STRONG LY SINGULAR KERNELS
A. C. Kaya and F. Erdogan Sep. 1985 25 p refs
(Grants NGR-39-007-011; NSF MEA-82-09083)
(NASA-CR-176687; NAS 1.26:176687) Avail: NTIS HC A02/MF A01 CSCL 12A

In this paper some useful formulas are developed to evaluate integrals having a singularity of the form (t-x) sup-m, m> or = 1. Interpreting the integrals with strong singularities in Hadamard sense, the results are used to obtain approximate solutions of singular integral equations. A mixed boundary value problem from the theory of elasticity is considered as an example. Particularly for integral equations where the kernel contains, in addition to the dominant term (t,x) sup-m, terms which become unbounded at the end points, the present technique appears to be extremely effective to obtain rapidly converging numerical results. Author

N86-26989*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REGULARITY ESTIMATES UP TO THE BOUNDARY FOR ELLIPTIC SYSTEMS OF DIFFERENCE EQUATIONS
J. C. Strikwerda, B. A. Wade (Wisconsin Univ., Madison.), and K. P. Bube (California Univ., Los Angeles.) May 1986 66 p refs Sponsored in part by Gulf Research and Development Co.
(Contracts NAS1-17070; NAS1-18107; Grants NsG-5034; NsG-5130; Contract DAAG29-80-C-0041; Grant NSF MCS-76-07039)
(NASA-CR-178107; ICASE-86-31; NAS 1.26:178107) Avail: NTIS HC A04/MF A01 CSCL 12A

Regularity estimates up to the boundary for solutions of elliptic systems of finite difference equations were proved. The regularity estimates, obtained for boundary fitted coordinate systems on domains with smooth boundary, involve discrete Sobolev norms and are proved using pseudo-difference operators to treat systems with variable coefficients. The elliptic systems of difference equations and the boundary conditions which are considered are very general in form. The regularity of a regular elliptic system of difference equations was proved equivalent to the nonexistence of eigensolutions. The regularity estimates obtained are analogous to those in the theory of elliptic systems of partial differential equations, and to the results of Gustafsson, Kreiss, and Sundstrom (1972) and others for hyperbolic difference equations. Author

N86-26990*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A SPECTRAL MULTIDOMAIN METHOD FOR THE SOLUTION OF HYPERBOLIC SYSTEMS
David Kopriva May 1986 48 p refs
(Contracts NAS1-17070; NAS1-18107)
(NASA-CR-178105; ICASE-86-28; NAS 1.26:178105) Avail: NTIS HC A03/MF A01 CSCL 12A

A multidomain Chebyshev spectral collocation method for solving hyperbolic partial differential equations were developed. Though spectral methods are global methods, an attractive idea is to break a computational domain into several domains, and a way to handle the interfaces is described. The multidomain approach offers advantages over the use of a single Chebyshev grid. It allows complex geometries to be covered, and local refinement can be used to resolve important features. For steady state problems it reduces the stiffness associated with the use of explicit time integration as a relaxation scheme. Furthermore, the proposed method remains spectrally accurate. Results showing performance of the method on one dimensional linear models and one and two dimensional nonlinear gas dynamics problems are presented. Author

N86-26991# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
CONTROL, STATE ESTIMATION AND PARAMETER IDENTIFICATION OF NONLINEAR DISTRIBUTED PARAMETER SYSTEMS USING FIXED POINT TECHNIQUES: A SURVEY
J. A. M. FelippedeSouza Apr. 1986 8 p refs Presented at the 4th IFAC Symposium on Control of Distributed Parameter Systems, Los Angeles, Calif. 29 Jun. - 3 Jul. 1986
(INPE-3855-PRE/919) Avail: NTIS HC A02/MF A01

Fixed point theorems have been an important tool used by mathematicians in the study of the existence of a solution of nonlinear differential equations, and nonlinear operator equations in general, since the beginning of the century. The last seven years has seen the appearance of some papers which extended the basic idea of this tool to solve problems of control, state estimation, and parameter identification of nonlinear systems, including distributed parameter systems. The present paper attempts to survey the fixed point techniques used in nonlinear distributed parameter systems in papers already published on this subject. The fact that most of these papers concentrate on theoretical results is emphasized. Though several of them bring creative ideas, they are poor in practical results or concrete examples of applications. Author

N86-26992*# Hampton Inst., Va. Dept. of Mathematics.
THE DESIGN AND IMPLEMENTATION OF COST-EFFECTIVE ALGORITHMS FOR DIRECT SOLUTION OF BANDED LINEAR SYSTEMS ON THE VECTOR PROCESSOR SYSTEM 32 SUPERCOMPUTER
Augustine S. Samba 1985 48 p
(Grant NAG1-544)
(NASA-CR-17681; NAS 1.26:176811) Avail: NTIS HC A03/MF A01 CSCL 12A

The problem of solving banded linear systems by direct (non-iterative) techniques on the Vector Processor System (VPS) 32 supercomputer is considered. Two efficient direct methods for solving banded linear systems on the VPS 32 are described. The vector cyclic reduction (VCR) algorithm is discussed in detail. The performance of the VCR on a three parameter model problem is also illustrated. The VCR is an adaptation of the conventional point cyclic reduction algorithm. The second direct method is the Customized Reduction of Augmented Triangles' (CRAT). CRAT has the dominant characteristics of an efficient VPS 32 algorithm. CRAT is tailored to the pipeline architecture of the VPS 32 and as a consequence the algorithm is implicitly vectorizable. Author

N86-26993# Los Alamos National Lab., N. Mex.
EXACT INTEGRATION ALGORITHM FOR USE WITH MODAL ANALYSIS
R. Rodeman 1985 6 p Presented at the 4th International Modal Analysis Conference, Los Angeles, Calif., 3 Feb. 1986
(Contract DE-AC04-76DP-00789)
(DE85-018533; SAND-85-2121C; CONF-860224-2) Avail: NTIS HC A02/MF A01

A modal analysis integration algorithm which is exact for a piecewise-linear excitation has been developed. Since virtually all field excitations are represented in digitized form, a piecewise-linear representation is appropriate. The integration algorithm is obtained by constructing a recursive, ramp-invariant digital filter. The recursive form is simple; only five additions and five multiplications are necessary to determine a new response point. This algorithm is compared with the Newmark-beta, central difference, trapezoidal rule, and linear-acceleration algorithms. It is shown that the new algorithm has a marked superiority. It is also shown that the classical algorithms can produce poor results. DOE

N86-26994# California Univ., Davis.
THE SOLUTION OF NONLINEAR TIME-DEPENDENT PROBLEMS USING MODAL COORDINATES Interim Report, Jan. - Sep. 1985
Kyran D. Mish, Darl M. Romstad, and Leonard R. Herrmann Dec. 1985 41 p
(Contract N62583-85-J-T168; NR Proj. Yr0-2303)
(AD-A163535; NCEL-CR-86.003) Avail: NTIS HC A03/MF A01 CSCL 12/1

An algorithm for the solution of a class of nonlinear time-dependent problems using reduced modal coordinates is proposed and implemented. Example problems in one space dimension are modeled, and comparisons made to exact solutions. The results

of these examples are used to make suggestions for further research. GRA

N86-26995# Naval Civil Engineering Lab., Port Hueneme, Calif.
A RECURSIVE BOUNDARY ELEMENT WITH INITIAL ERROR INVESTIGATION Final Report, Oct. 1984 - Sep. 1985
J. V. Cox and T. A. Shugar Dec. 1985 49 p
(AD-A163563; NCEL-TN-1730) Avail: NTIS HC A03/MF A01 CSCL 12/1

A recursive numerical integration technique is developed for the boundary element method. The initial implementation is within an indirect formulation for two-dimensional elastostatics. A numerical study investigates the error field near a single boundary element in the infinite plane using different orders of numerical integration. The difficulty of integrating the singular kernal functions with discrete integration points is eliminated with a recursive algorithm that adaptively subdivides elements that are in close proximity to the internal response point. The recursive technique allows calculation of internal responses arbitrarily close to the boundary subdivision based on boundary geometry and anticipated boundary response gradients without regard for the numerical integration accuracy of responses near the boundary. The gradient of the artificial tractions must ordinarily be considered when modeling problems with the indirect formulation. GRA

N86-26996# Wisconsin Univ., Madison. Mathematics Research Center.
THE ORDINARY LEAST SQUARES ESTIMATION FOR THE GENERAL-LINK LINEAR MODELS, WITH APPLICATIONS Technical Summary Report
Naihua Duan and Ker-Chau Li Oct. 1985 34 p refs
(Contract DAAG29-80-C-0041; Grant NSF MCS-83-01587)
(AD-A163599; MRC-TSR-2880) Avail: NTIS HC A03/MF A01 CSCL 12/1

For a general link linear model (GLLM), we show that the OLS estimate of the slope vector is strongly consistent up to a multiplicative scale, even though the model might actually be nonlinear. Furthermore, the estimated slope vector is strongly consistent for the average slope vector, the average of the pointwise slope vectors on the response surface. For a GLLM with a completely specified link function, we can solve for the multiplicative scalar and estimate the intercept and Cox and Snell's generalized residuals. We then estimate the response surface and the pointwise slopes using a generalization of the smearing estimate in Duan (1983). The results can be applied to a number of important subclasses of GLLM, including general transformation models, general scaled transformation models, dichotomous regression, and Tobit regression. GRA

N86-26997# National Bureau of Standards, Gaithersburg, Md. Center for Applied Mathematics.
MARCHING DIFFERENCE SCHEMES FOR ILL POSED INITIAL VALUE PROBLEMS Final Report, 16 Jul. 1982 - 30 Sep. 1985
Alfred S. Carasso 30 Nov. 1985 6 p refs
(Contract MIPR-ARO-63-82)
(AD-A164012; ARO-19643.4-MA) Avail: NTIS HC A02/MF A01 CSCL 12/1

This final report summarizes work accomplished on the development of marching algorithms for the numerical computation of ill-posed initial value problems. Applications include nonlinear inverse heat transfer in gun barrels, and the detection of flaws in metallic plates by ultrasonic testing. A new systematic approach to pulse probing and characterization of linear time invariant systems was discovered. This theory uses tools from probability theory related to the Central Limit Theorem. Important computational experiments were successfully performed on reconstructing singular elastic Green's functions. Author (GRA)

N86-26998# Pittsburgh Univ., Pa. Center for Multivariate Analysis.
THE RELATIVE ENTROPY OF A RANDOM VECTOR WITH RESPECT TO ANOTHER RANDOM VECTOR
M. Rosenblatt-Roth Oct. 1985 72 p refs
(Contract F49620-82-K-0001)
(AD-A164093; TR-85-35; AFOSR-86-0036TR) Avail: NTIS HC A04/MF A01 CSCL 12/1

This paper discusses some problems connected with the concept of entropy. GRA

N86-26999# California Univ., Santa Barbara. Dept. of Physics.
DENSITY FUNCTIONAL THEORY FOR EXCITED STATES IN A QUASI LOCAL DENSITY APPROXIMATION Technical Report, Jun. - Dec. 1985
W. Kohn 10 Feb. 1986 11 p
(Contract N00014-84-K-0548)
(AD-A164474; TR-9) Avail: NTIS HC A02/MF A01 CSCL 07/4

The starting point of this paper is a recent extension by A.K. Theophilou of the Hohenberg-Kohn-Sham(HKS) density functional theory to ensembles of systems consisting of the M lowest eigenstates, equally weighted. As in the HKS theory the key quantities are the exchange correlation energy, E(supM, sub xc) [n (r')] and potential v sup M, sub xc (r; [n (r')]). This paper provides expressions for these quantities, valid for systems of slowly varying density. Even for such systems, however, there are essential non-local effects. Nevertheless, both E (sup M, sub xc) and v (sup M, sub xc) can be calculated in terms of quantities characteristic of appropriate uniform thermal ensembles. This theory is the analog of the ground state local density approximation and allows calculation of excited state energies and densities. GRA

N86-27000# Yale Univ., New Haven, Conn. Dept. of Computer Science.
END-POINT CORRECTED TRAPEZOIDAL QUADRATURE RULES FOR SINGULAR FUNCTIONS
V. Rokhlin Nov. 1985 16 p
(Contract N00014-82-K-0184)
(AD-A163242; YALEU/DCS/RR-441) Avail: NTIS HC A02/MF A01 CSCL 12/1

A group of quadrature formulae for end-point singular functions is presented generalizing classical end-point corrected trapezoidal quadrature rules. The actual values of the end-point corrections are obtained for each singularity as a solution of a system of linear algebraic equations. The algorithm is applicable to a wide class of monotonic singularities and does not require that an analytical expression for the singularity be known; only the knowledge of its first several moments and the ability to evaluate it on the interval of integration are needed. Author (GRA)

N86-27001# Johns Hopkins Univ., Baltimore, Md. Dept. of Mathematical Sciences.
THE MATHEMATICAL STRUCTURE OF ERROR CORRECTION MODELS
Soren Johansen May 1985 40 p refs
(Contract N00014-79-C-0801)
(AD-A163344; TR-461; TR-85-10-ONR) Avail: NTIS HC A03/MF A01 CSCL 12/1

The error correction model for a vector valued time series has been proposed and applied in the economic literature with the papers by Sargan (1964), Davidson et al. (1978), Hendry and von Ungern-Sternberg (1981) and has been given a formal mathematical treatment by Granger (1983). He introduced the notion of cointegratedness of a vector process and showed the relation between cointegration and error correction models. This paper defines a general error correction model, that encompasses the usual error correction model as well as the integral correction model by allowing a finite number of error correction terms which correspond to linear combinations of the vector process that are integrated of different order. It is shown that this structure is inherent in the model if it is given in autoregressive form or moving average form by exploiting the singularity of the matrix function that defines the model. The theory is applied to some examples discussed by Davidson (1983) and Harvey (1982). Author (GRA)

N86-27002# Johns Hopkins Univ., Baltimore, Md. Dept. of Mathematical Sciences.

ON DENSITY ESTIMATION FROM CENSORED DATA BY PENALIZED LIKELIHOOD METHODS
V. K. Klonias and John C. Wierman Jun. 1985 28 p
(Contract N00014-79-C-0801)
(AD-A163388; TR-418; ONR-TR-85-3) Avail: NTIS HC A03/MF A01 CSCL 12/1

Estimators for the probability density function, cumulative distribution function, and hazard function are proposed in the random censorship setting. The estimators are derived from the Kaplan-Meier product limit estimator by maximum penalized likelihood methods. The authors establish the existence and uniqueness of the estimates, which are exponential splines with knots at the uncensored observations, and provide an efficient algorithm for their numerical evaluation. They prove the consistency, in probability and almost surely, of the density estimates in the Hellinger distance, the L sub p norms for p =1, 2, infinity, and the Sobolev norm. The corresponding hazard rate estimator converges uniformly on bounded intervals. Author (GRA)

N86-27003# Stanford Univ., Calif. Dept. of Statistics.
CONVEXITY OF ELLIPTICALLY CONTOURED DISTRIBUTIONS WITH APPLICATIONS
S. Iyengar and Y. L. Tong 10 Dec. 1985 23 p
(Contract N00014-76-C-0475)
(AD-A163389; SU-TR-368) Avail: NTIS HC A02/MF A01 CSCL 12/1

The problem of evaluating multivariate probabilities arises in many areas of statistics, such as in the construction of confidence regions for the mean vector or regression parameters in a general linear model, the determination of critical regions for certain tests, multiple comparisons, reliability, etc. Because these probabilities are hard to evaluate numerically, a thorough study of the nature of, say, the distribution function is needed to suggest good approximations and inequalities. For example, tables for selected values of parameters are available, and one usually interpolates linearly to get an approximation; if we know that the tabulated function is convex or concave, we also get a bound for the quantity of interest. The cumulative and rectangular probabilities for elliptically contoured distributions are increasing functions of the correlations, but the rate of increase has not yet been studied. This paper proves some results concerning the convexity in correlations of the distribution functions of random vectors with elliptically contoured distributions, and their absolute values. Sections 2-5 describe the bivariate case, and the last section contains extensions to the multivariate case; the results here are not as strong as for the bivariate case, as the computations are much harder. GRA

N86-27004# Johns Hopkins Univ., Baltimore, Md. Dept. of Mathematical Sciences.
A NOTE ON CONVERGENCE OF FUNCTIONS OF RANDOM ELEMENTS
Robert J. Serfling Nov. 1985 12 p
(Contract N00014-79-C-0801)
(AD-A163405; TR-459; TR-85-8-ONR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Convergence of g(xi sub n) to g (xi) is considered when xi sub n approaches limit of xi distribution or in probability, without the usual restriction that g be continuous a.s. under the distribution of xi. It is shown that the covergence g (xi sub n) approaches limit of g (xi) holds for arbitrary Borel-measurable g, if in addition to the assumed convergence xi sub n approaches limit of xi the corresponding measures (p sub N) of (xi sub) are contiguous to the measure of P of xi in a certain very weak sense. Some statistical applications are indicated. GRA

N86-27005# Pittsburgh Univ., Pa. Center for Multivariate Analysis.
COMPUTATION OF THE STATIONARY VALUES OF THE PRODUCT OF TWO RALEIGH QUOTIENTS
C. R. Rao and C. V. Rao Sep. 1985 16 p refs
(Contract F49620-85-C-0008)
(AD-A164586; TR-85-34; AFOSR-86-0038TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

A computational algorithm is developed for finding the stationary values of the function x'Cx/ square root of (x'Ax) square root of (x'Bx) where A and B are positive definite and C is a symmetric matrix. The square of the function under consideration is the product of two Raleigh coefficients x'Cx/x'Ax and x'Cx/x'Bx. The general problem occurs in multivariate analysis in the computation of homologous canonical variates in studying relationships between two sets of homologous measurements. The special case with C=I occurs in designing control systems with minimum norm feedback matrices. Author (GRA)

N86-27006# Florida State Univ., Tallahassee. Dept. of Statistics.
AN EXACT TEST FOR THE NESTING EFFECT'S VARIANCE COMPONENT IN AN UNBALANCED RANDOM TWO-FOLD NESTED MODEL
Andre I. Khuri and Ramon C. Littell Jan. 1986 16 p refs
(Contract N00014-86-K-0059)
(AD-A164607; TR-248) Avail: NTIS HC A02/MF A01 CSCL 12/1

An exact test is presented to evaluate the significance of the nesting effect's variance components in an unbalanced random two-fold nested model. The power of this test is compared to power values obtained under other approximate tests. Author (GRA)

N86-27007# Minnesota Univ., Duluth.
METASTABILITY AND COMPENSATED COMPACTNESS IN CONTINUUM THEORIES Final Report, 1 Dec. 1984 - 30 Nov. 1985
Hans Weinberger and George R. Sell 23 Jan. 1986 13 p
(Contract DAAG29-85-K-0021)
(AD-A164634; ARO-21859.1-MA) Avail: NTIS HC A02/MF A01 CSCL 12/1

Historically, one of the most important problems in continuum mechanics has been the understanding of hyperbolic conservation laws. This is because such systems arise from the underlying balance laws of mass, momentum, and energy. Their nonlinearity and hyperbolicity arise from the simplest constitutive assumptions, even in an ideal gas. The goal of this workshop was to examine the implications of compensated compactness and dispersion in the analysis and numerical analysis of such equations. The influence of viscosity and fluctuation mechanisms in nature was discussed as well. A second workshop focused on metastability and incompletely posed problems. GRA

N86-27008# Florida Univ., Gainesville. Dept. of Statistics.
MEASURES OF IMBALANCE FOR UNBALANCED MODELS
Andre I. Khuri Jan. 1986 26 p
(Contract N00014-86-K-0059)
(AD-A164638; TR-255) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper presents a procedure to measure the degree of imbalance of an unbalanced data set. The procedure is based on choosing an appropriate loglinear model for the subclass frequencies of the data. A measure of imbalance is then introduced as some function of the chi-squared statistic used in the goodness-of-fit test for the loglinear model. The proposed procedure can also be used to measure departures from certain types of balance, such as proportionality of subclass frequencies, partial balance, and last-stage uniformity. Author (GRA)

N86-27009# Stanford Univ., Calif. Lab. for Computational Statistics.
ON FREQUENCY POLYGONS AND AVERAGE SHIFTED HISTOGRAMS IN HIGHER DIMENSIONS
Nils L. Hjort Feb. 1986 55 p
(Contract N00014-83-K-0472)
(AD-A164680; SU-LCS-TR-22) Avail: NTIS HC A04/MF A01 CSCL 12/1

Scott has recently studied two simple variations on the ordinary histogram, namely the frequency polygon and the average shifted

histogram, and found that they are able to compete with for example kernel density estimators in performance while retaining the advantage of being conceptually and computationally simple. The present paper proposes a way of generalizing frequency polygons to d-dimensional space that performs better than Scott's generalization. Expressions for integrated mean squared error and for integrated mean absolute deviation plus integrated absolute bias are obtained for generalized frequency polygons, for average shifted histograms, and for generalized frequency polygons of average shifted histograms. These expressions are used to give guidelines for window sizes. GRA

N86-27010# Ballistic Research Labs., Aberdeen Proving Ground, Md.
ON THE EXISTENCE OF LI-YORKE POINTS IN THE THEORY OF CHAOS
Nam P. Bhatia and Walter O. Egerland Jan. 1986 15 p refs
(AD-A164691; BRL-TR-2702) Avail: NTIS HC A02/MF A01 CSCL 12/1

The report establishes an addendum to the Li-Yorke theorem, lists the complete set of Li-Yorke inequalities, and provides in the Equivalence theorem nonperiodic conditions equivalent to the known periodic conditions that guarantee chaos. Author (GRA)

N86-27011# Air Force Geophysics Lab., Hanscom AFB, Mass.
A REVIEW OF MAXIMUM ENTROPY SPECTRAL ANALYSIS AND APPLICATIONS TO FOURIER SPECTROSCOPY
Edmond M. Dewan 3 Apr. 1985 80 p
(AD-A164698; AFGL-TR-85-0091; AFGL-ERP-911) Avail: NTIS HC A05/MF A01 CSCL 12/1

There are many situations where a great increase in the resolution of power spectral densities, PSD's, would solve important problems. The problem areas range from radar, speech compression, seismic signal processing, to spectral analysis of optical signals. The maximum entropy method (MEM) can, under certain circumstances, provide an order of magnitude increase in resolution over conventional techniques. The fundamental concepts and mathematical background are given and, most importantly, the peculiarities and new features introduced by the MEM technique are explained. Some signals are good candidates for this technique while others are not; thus, methods are described to distinguish between the two. After the techniques to obtain the MEM-PSD are explained, an application to Fourier Spectroscopy is given to illustrate the results (as compared to conventional means). This review employs certain features to make the MEM approach accessible to those without previous knowledge about it. These features include: a short history of the PSD which describes the evolution over time of the basic concepts; a discussion of the higher principle of maximum entropy in the context of probability theory; a simple introduction to the Z-transform and how it introduces the basic spectral line shape of the MEM-PSD as well as other peculiarities of the method which distinguish it from the conventional approach; the physics behind the reflection coefficients which are introduced by MEM; and an extensive annotated bibliography. GRA

N86-27012# Naval Research Lab., Washington, D. C.
A UNIFYING APPROACH TO LINEAR AND NONLINEAR ARRAY PROCESSING: A TUTORIAL Final Report, Oct. 1984 - Sep. 1985
Charles L. Byrne 30 Dec. 1985 31 p
(AD-A164777; NRL-8959) Avail: NTIS HC A03/MF A01 CSCL 12/1

The concept of linear filtering is the focus of a unifying approach to linear and nonlinear array processing methods. A number of well-known methods (conventional, optimal, maximum likelihood) are typically discussed within the context of linear filtering, while others (maximum entropy, linear predictor, generalized eigenvector) are not usually presented in this way. Through rederivation of these methods in terms of constrained filtering, we are able to relate performance of the methods to imposed (or neglected) constraints. Each filter discussed is linearly constrained in the look direction and then optimized using quadratic forms based on noise and sidelobe structure. Each filter is more complicated than the ones preceding it, as we consider additional aims and impose additional constraints. Stability of the methods to mismatches is considered, and techniques for improving stability are presented. Appendixes on Fourier transform approximation, array gain and detection, and complex Gaussian random variables are included. Author (GRA)

N86-27013# Emory Univ., Atlanta, Ga. Dept. of Chemistry.
TIME DOMAIN FILTERING OF TWO-DIMENSIONAL FLUORESCENCE DATA Interim Technical Report
Maria Vicsek, Sharon L. Neal, and Isiah M. Warner 10 Feb. 1986 27 p Submitted for publication
(Contract N00014-83-K-0026; Grant NSF CHE-82-01886; NR Proj. 051-841)
(AD-A164954) Avail: NTIS HC A03/MF A01 CSCL 05/8

Four time domain filtering methods are applied to simulated and experimental two dimensional fluorescence data in order to evaluate their performance. The methods that were evaluated are: (1) moving average, (2) Savitsky Golay polynomial smoothing, (3) Chebyshev filtering, and (4) Bicubic spline filtering. The methods are compared using mean square error analysis and the difference in the amplitudes of the filtered noisy and ideal data. The two dimensional version of the Savitsky Golay filtering and the spline method produced the best overall results. GRA

N86-27014# Naval Postgraduate School, Monterey, Calif.
THE FRACTAL GEOMETRY OF NATURE; ITS MATHEMATICAL BASIS AND APPLICATION TO COMPUTER GRAPHICS M.S. Thesis
Michael E. Gaddis and Michael J. Zyda Jan. 1986 131 p
(AD-A165185; NPS52-86-008) Avail: NTIS HC A07/MF A01 CSCL 12/1

Fractal Geometry is a recent synthesis of old mathematical constructs. It was first popularized by complex renderings of terrain on a computer graphics medium. Fractal geometry has since spawned research in many diverse scientific disciplines. Its rapid acceptance has been achieved due to its ability to model phenomena that defy discrete computation due to roughness and discontinuities. With its quick acceptance have come problems. Fractal geometry is a misunderstood idea that is quickly becoming buried under grandiose terminology that serves no purpose. Its essence is induction using simple geometric constructs to transform initiating objects. The fractal objects that we create with this process often resemble natural phenomena. The purpose of this thesis is to present fractal geometry to the graphics programmer as a simple workable technique. We hope to demystify the concepts of fractal geometry and make it available to all who are interested. Author (GRA)

N86-27015# Texas Univ., Austin. Inst. for Fusion Studies.
SPONTANEOUS SYMMETRY BREAKING AND NEUTRAL STABILITY IN THE NONCANONICAL HAMILTONIAN FORMALISM
P. J. Morrison and S. Eliezer Oct. 1985 36 p
(Contract DE-FG05-80ET-53088)
(DE86-004562; DOE/ET-53088/212; IFSR-212) Avail: NTIS HC A03/MF A01

The noncanonical Hamiltonian formalism is based upon a generalization of the Poisson bracket, a particular form of which is possessed by continuous media fields. Associated with this generalization are special constants of motion called Casimirs. These are constants that can be viewed as being built into the phase space, for they are invariant for all Hamiltonians. Casimirs are important because when added to the Hamiltonian they yield an effective Hamiltonian that produces equilibrium states upon variation. The stability of these states can be ascertained by a second variation. Goldstone's theorem, in its usual context, determines zero eigenvalues of the mass matrix for a given vacuum state, the equilibrium with minimum energy. Here, since for fluids and plasmas the vacuum state is uninteresting, we examine symmetry breaking for general equilibria. Broken symmetries imply directions of neutral stability. Two examples are

presented: the nonlinear Alfven wave of plasma physics and the Korteweg-de Vries soliton. DOE

N86-27016# Los Alamos National Lab., N. Mex.
APPROACH TO ERROR-ESTIMATION IN THE APPLICATION OF DIMENSION ALGORITHMS
J. Holzfuss and G. Mayer-Kress 1985 12 p Presented at the International Conference on Dimensions and Entropies in Chaotic Systems, Pecos River, N.M., 11 Sep. 1985
(Contract W-7405-eng-36)
(DE86-004733; LA-UR-85-4265; CONF-8509203-3) Avail: NTIS HC A02/MF A01

Three different methods for calculating the dimension of attractors are analyzed. An approach to error-estimation is presented and is used on various datasets. It is shown that in some cases the errors can become very large. DOE

N86-27017# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
CAYLEY CAGES
P. M. vandenBroek Nov. 1984 12 p
(Memo-448; ESA-86-96965) Avail: NTIS HC A02/MF A01

A (d,g)-Cayley cage is defined to be a Cayley graph of degree d and girth g with minimum number of points. Cayley cages are determined for several values of the degree and the girth, among them a (3,5)-Cayley cage with 50 points and (d,6)-Cayley cages for those values of d for which d-1 is a prime power. Upper bounds are derived for the number of points of all Cayley cages with girth not exceeding 6. ESA

N86-27018# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
AN EFFICIENT DECISION-MAKING-FREE FILTER FOR PROCESSES WITH ABRUPT CHANGES
H. A. P. Blom 10 Sep. 1984 10 p Presented at 7th IFAC Symposium on Identification and System Parameter Estimation, York, England, 3-7 Jul. 1985
(NLR-MP-84080-U; B8578435; ESA-86-96970) Avail: NTIS HC A02/MF A01

The system of linear stochastic difference equations with Markovian coefficients was generalized to cover processes in R sup n which jump simultaneously with the coefficients. The additional modeling potential of this generalized system is illustrated. For filtering partial observations of the generalized system, the Interacting Multiple Model (IMM) algorithm is given. It consists of a bank of N interacting Kalman-like filters which cooperate with a filter for the N state Markov process and is free of any decision making mechanism. Comparisons with other algorithms for processes with abrupt changes show that the IMM algorithm performs very well at the cost of a relatively low computational load. Due to the generalization, the IMM algorithm is a serious competitor of decision directed filters for processes in R sup n with additive jumps. ESA

N86-27019# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Mathematical Statistics.
ON THE LIKELIHOOD RATIO TEST FOR A CHANGE POINT IN A SEQUENCE OF INDEPENDENT EXPONENTIALLY DISTRIBUTED RANDOM VARIABLES
Patsy Haccou (Leiden Univ., Netherlands), Evert Meelis, and Sara vandeGeer Aug. 1985 34 p refs
(CWI-MS-R8507; B8573005; ESA-86-96986) Avail: NTIS HC A03/MF A01

Let x1, ..., xn + 1 be independent exponentially distributed random variables, and let xi have intensity lambda 1 for i < or = tau, and intensity lambda 2 for i > tau, where tau is an unknown instant and lambda 1 and lambda 2 are also unknown. It is proved that the asymptotic null-distribution of the likelihood ratio statistic for testing lambda 1 = lambda 2 (or, equivalently, tau = 0 or n + 1) is an extreme value distribution, by application of theorems concerning the normed uniform quantile process. The rate of convergence is studied with Monte Carlo methods. Since it appears very low, simulated 5% critical values are given. It is shown that the test is optimal in the sense of Bahadur. Simulation results indicate a good power for values of n that are relevant for most applications. The likelihood ratio test is compared with a test which has the same asymptotic null-distribution. It is proved that this test has Bahadur efficiency zero. The simulation results confirm that the likelihood ratio test is superior to the latter test. ESA

N86-27020# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research and System Theory.
RESIDUE FORMULAS FOR MEROMORPHIC MATRICES
J. M. Schumacher Sep. 1985 16 p Revised Submitted for publication
(CWI-OS-R8506; B8577117; ESA-86-96988) Avail: NTIS HC A02/MF A01

Derivation of the so-called participation matrices which govern the energy distribution over the resonance modes in vibration analyses of mechanical systems is discussed. These matrices appear as residue matrices for certain meromorphic matrix-valued functions (transfer matrices from forces to displacements), the poles of which correspond to the resonance frequencies. These poles are simple as a consequence of the law of conservation of energy. The problem comes down to the computation of the residue at a simple pole of a meromorphic matrix. A residue formula (and variants) for matrices in fractional form is given. In all versions, a normalizing matrix which is invertible if and only if the pole considered is simple is constructed, and a formula for the residue which features the inverse of the normalizing matrix is written. Proofs are based on the local Smith form for meromorphic matrices. The normalizing matrix can also be used in stability tests. ESA

N86-27021# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research and System Theory.
WAITING-TIME APPROXIMATIONS FOR CYCLIC-SERVICE SYSTEMS WITH SWITCHOVER TIMES
O. J. Boxma and B. Meister (IBM Research Lab., Zurich, Switzerland) Sep. 1985 19 p Revised Submitted for publication
(CWI-OS-R8510; B8577110; ESA-86-96992) Avail: NTIS HC A02/MF A01

Mean waiting-time approximations are derived for a single-server multiqueue system with nonexhaustive cyclic service. Nonzero switchover times of the server between consecutive queues are assumed. A pseudo-conservation law was found by Watson (1984). The approximation is simpler and, as extensive simulations show, more accurate than existing approximations. It gives very good insight into the qualitative behavior of cyclic-service queueing systems. ESA

N86-27022# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Applied Mathematics.
A DOUBLE INTEGRAL CONTAINING THE MODIFIED BESSEL FUNCTION: ASYMPTOTICS AND A DEVICE FOR COMPUTATION
N. M. Temme Apr. 1985 10 p Revised Submitted for publication
(CWI-AM-R8507; B8578041; ESA-86-96993) Avail: NTIS HC A02/MF A01

A two-dimensional integral containing exp (- xi - eta)I0(2 root xi eta) is considered; I0(z) is the modified Bessel function and the integral is taken over the rectangle 0 < or = xi < or = x, 0 < or = eta < or = y. The integral is difficult to compute when x and y are large, especially when x and y are almost equal. Computer programs based on existing series expansions are inefficient in this case. A representation in terms of the error function (normal distribution function) from which more efficient and reliable algorithms can be constructed is given. ESA

N86-27023# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Applied Mathematics.
AN ABSTRACT DELAY-DIFFERENTIAL EQUATION MODELING SIZE DEPENDENT CELL GROWTH AND DIVISION
M. Gyllenberg (Helsinki Univ., Finland) and H. J. A. M. Heijmans

Apr. 1985 18 p Revised
(CWI-AM-R8508; B8578042; ESA-86-96994) Avail: NTIS HC A02/MF A01

A two-phase model for the growth of a single cell population structured by size is formulated and analyzed. The model takes the form of a delay-differential equation in a Banach space. Using positivity arguments, the spectrum of the infinitesimal generator of the semigroup associated with solutions is described. Under a certain condition on the growth rate of individual cells the semigroup is compact after finite time. This is used to determine the ultimate behavior of solutions and prove the existence of a stable size distribution. ESA

N86-27024# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Applied Mathematics.
THE SIZE AND SCAR DISTRIBUTIONS OF THE YEAST SACCHAROMYCES CEREVISIAE
Mats Gyllenberg (Helsinki Univ., Finland) May 1985 21 p Revised Submitted for publication
(CWI-AM-R8509; B8578043; ESA-86-96995) Avail: NTIS HC A02/MF A01

A model for the growth of populations of Saccharomyces cerevisiae is formulated and analyzed. The probability of bud emergence is assumed to depend on the size of the cell. Under certain conditions on birth size the model can be reduced to a single renewal equation. Using Laplace transform techniques and renewal theory, the existence of a stable scar and size distribution under certain conditions on the growth rate of individual cells is established. The steady state values for the relative frequencies of unbudded and budded cells in the various scar classes are given. ESA

N86-27025# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Applied Mathematics.
A DIFFERENTIAL-INTEGRAL EQUATION MODELING THE DYNAMICS OF POPULATIONS WITH A RANK STRUCTURE
Horst R. Thieme (Heidelberg Univ., West Germany) Jul. 1985 25 p Revised Submitted for publication Sponsored by Deutsche Forschungsgemeinschaft
(CWI-AM-R8511; B8578045; ESA-86-96997) Avail: NTIS HC A02/MF A01

In order to illustrate the stabilizing potential of rank structures for the development of populations, a differential-integral equation (differentiation in time, integration over rank) modeling the dynamics of rank-structured (e.g., territorially or hierarchically organized) populations is proposed. After establishing existence and uniqueness of solutions, it is proved that, under biologically interpretable conditions, the population either dies out or tends towards a uniquely determined nonzero equilibrium state. Which of these alternatives actually occurs depends on the reproductive potential of the population and the permeability of the rank structure. ESA

N86-27026# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
READY TRACE SEMANTICS FOR CONCRETE PROCESS ALGEBRA WITH PRIORITY OPERATOR
J. C. M. Baeten (Amsterdam Univ., Netherlands), J. A. Bergstra (Utrecht State Univ., Netherlands), and J. W. Klop Aug. 1985 25 p Revised Submitted for publication Sponsored by European Economic Commission ESPRIT Project 432
(CWI-CS-R8517; B8575500; ESA-86-97008) Avail: NTIS HC A02/MF A01

A process semantics intermediate between bisimulation semantics and readiness semantics, called ready trace semantics is considered. The advantage of this semantics is that, while retaining the simplicity of readiness semantics, it is possible to augment this process model with the mechanism of atomic actions with priority (theta operator). It is shown that in readiness semantics, and a fortiori in failure semantics, such an extension with theta is impossible. Ready trace semantics is considered in the setting of concrete process algebra, i.e., without abstraction (no silent moves) and for finite processes only. For such finite processes without silent moves, a complete axiomatization of ready trace semantics is given via the method of process graph transformations. ESA

N86-27027# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
GLOBAL RENAMING OPERATORS IN CONCRETE PROCESS ALGEBRA Annual Report, 1984
J. C. M. Baeten and J. A. Bergstra Sep. 1985 33 p Revised report of RUU-CS-85-3 Submitted for publication Sponsored in part by European Economic Commission ESPRIT Project 432
(CWI-CS-R8521; B8575494; ESA-86-97012) Avail: NTIS HC A03/MF A01

Renaming operators are introduced in concrete process albegra (i.e., abstraction and silent moves are not considered). Examples of renaming operators are given: encapsulation, pre-abstraction, and localization. It is shown that renamings enhance the defining power of concrete process algebra by using the example of a queue. The trace set of a process is defined, and it is shown when equality of trace sets implies equality of processes. Trace sets are used to define the restriction of a process. Processes with actions that have a side effect on a state space are described, and how to use them for translation of computer programs into process algebra is outlined. ESA

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N86-27028# Stanford Univ., Calif. Dept. of Statistics.
ESTIMATES OF CIRCULAR ERROR PROBABILITIES
M. Evans, Z. Govindarajulu, and J. Barthoulot 5 Dec. 1985 25 p
(Contract N00014-76-C-0475)
(AD-A163257; SU-TR-367) Avail: NTIS HC A02/MF A01 CSCL 19/5

The general problem of the estimation of P sub theta (C) where C is some fixed event and P sub theta is unknown in some class is considered. The various available estimation procedures seem to involve the choice of some random probability measure. In particular we consider this problem when C is a disk in Sq R centered at o and P sub theta is restricted to be bivariate normal. Details concerning the implementation of the estimation procedures and a Monte Carlo study are discussed for this case. This particular problem arises when we are concerned with assessing the accuracy of a targeting procedure.
Author (GRA)

N86-27029# Johns Hopkins Univ., Baltimore, Md. Dept. of Mathematical Sciences.
A BAHADUR REPRESENTATION FOR QUANTILES OF EMPIRICAL DFs GENERALIZED U-STATISTIC STRUCTURE
Robert J. Serfling Nov. 1985 21 p
(Contract N00014-79-C-0801)
(AD-A163311; TR-453; TR-85-6-ONR) Avail: NTIS HC A02/MF A01 CSCL 12/1

A wide class of c-sample statistics can be represented conveniently as quantiles of a nonclassical empirical df having the structure of a generalized U-statistic. A key tool in studying classical quantiles has been the Bahadur representation. This paper provides a suitable extension of that tool to the generalized setting. As auxiliary lemmas, some new results for generalized U-statistics are developed. Also, some further results for empirical df's of generalized U-statistic structure and their corresponding quantiles are provided. Author (GRA)

N86-27030# Johns Hopkins Univ., Baltimore, Md. Dept. of Mathematical Sciences.
ON THE LEAST-INFORMATIVE DISTRIBUTION IN A CONTAMINATION NEIGHBORHOOD
John C. Wierman and Kenneth S. Cantwell Jun. 1985 18 p
(Contract N00014-79-C-0801; Grant NSF MCS-83-03238)
(AD-A163312; TR-434; TR-85-2-ONR) Avail: NTIS

HC A02/MF A01 CSCL 12/1

For a board class of model distributions G, this document determines the distribution minimizing Fisher information for location in the epsilon-contamination neighborhood of G. The class consists of distributions G with a density g such that psi sub g = -g'/g is continuously differentiable and psi ' sub g has finitely many intervals of increase. The result is extended to the scale problem.
Author (GRA)

N86-27031# Johns Hopkins Univ., Baltimore, Md. Dept. of Mathematical Sciences.
GENERALIZED ORDER STATISTICS, BAHADUR REPRESENTATIONS AND SEQUENTIAL NONPARAMETRIC FIXED-WIDTH CONFIDENCE INTERVALS
J. Choudhury and R. J. Serfling Oct. 1985 29 p
(Contract N00014-79-C-0801)
(AD-A163329; TR-445; TR-85-4-ONR) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper introduces confidence intervals formed by a pair of generalized order statistics, develops Bahadur-type representation theory for these order statistics, and constructs corresponding sequential fixed-width confidence interval procedures. Previous work related to the subject is sharpened and extended. GRA

N86-27032# Johns Hopkins Univ., Baltimore, Md. Dept. of Mathematical Sciences.
ASYMPTOTIC NORMALITY OF U-STATISTICS BASED ON TRIMMED SAMPLES
Paul Janssen, Robert Serfling, and Noel Veraverbeke Nov. 1985 20 p
(Contract N00014-79-C-0801)
(AD-A163346; TR-450; ONR-85-5) Avail: NTIS HC A02/MF A01 CSCL 12/1

For robust estimation of location, the ordinary sample mean is too sensitive to outliers. A classical and successful alternative is the trimmed mean, for which asymptotic normality was established by Bickel (1965). As discussed by Bickel and Lehmann (1975), for example, the trimmed mean remains relatively efficient with respect to the untrimmed mean even in the absence of outliers. Viewing the trimmed mean as simply the ordinary mean defined on a trimmed sample, we are motivated to consider other common statistics as well in this regard. This paper studies U-statistics in such fashion. The class of U-statistics, introduced by Hoeffding (1948), contains a wealth of statistics of interest in their own rights and also contains statistics which serve as approximations to statistics of more complicated type. A very significant broadening of the scope of robust statistical inference is achieved, therefore, by consideration of the class of U-statistics on trimmed samples.
GRA

N86-27033# Naval Postgraduate School, Monterey, Calif.
PROPERTIES OF BATCH MEANS FROM STATIONARY ARMA (AUTOREGRESSIVE MOVING AVERAGE) TIME SERIES
Keebom Kang and Bruce Schmeiser Feb. 1986 13 p
(AD-A165187; NPS55-86-004) Avail: NTIS HC A02/MF A01 CSCL 12/1

The batch means process arising from an arbitrary autoregressive moving-average (ARMA) process time series is derived. As side results, the variance and correlation structures of the batch means process as functions of the batch size and parameters of the original process are obtained. Except for the first-order ARMA process, for which a closed-form expression is obtained, the parameters of the batch-means process are determined numerically. Author (GRA)

N86-27034# Bielefeld Univ. (West Germany). Research Center.
STOCHASTIC MECHANICS AND THE KEPLER PROBLEM
P. Garbaczewski (Wroclaw Univ., Poland) 1986 16 p Sponsored by Stiftung Volkswagenwerk
(Rept-70; ESA-86-96929) Avail: NTIS HC A02/MF A01 Member States, AU, CN, NO (+20% others)

Nelson-Guerra's stochastic mechanics is formulated for the hydrogen atom. It is demonstrated that this simple quantum system can be described in terms of three independent Gaussian Markov processes, driven (controlled) by the classical Kepler problem. It reveals a manifest connection between the classical and quantized versions of the Kepler problem. ESA

N86-27035# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
A SOLUTION METHOD FOR THE SET PACKING PROBLEM WITH POLYHEDRAL CHARACTERISTICS
Sjored M. Baas and Martin C. Bonvanie May 1984 21 p
(Memo-446; ESA-86-96964) Avail: NTIS HC A02/MF A01

The concept of solving combinatorial problems with the help of relevant information on the facetial structure of the underlying polytope is used in connection with Set Packing (SP) problems. An algorithm is presented in which a standard list of simple facet inequalities is investigated as to its efficiency to solve a general SP problem of average size (40 to 60 variables) in a limited number of iterations. Within each iteration relevant facet inequalities are derived by considering the corresponding intersection graph. Precise expressions for these inequalities can be established with the help of a specific sequential facet lifting procedure. ESA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N86-27036*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A LUMPED PARAMETER MATHEMATICAL MODEL FOR SIMULATION OF SUBSONIC WIND TUNNELS
Susan M. Krosel, Gary L. Cole, William M. Bruton, and John R. Szuch May 1986 50 p refs
(NASA-TM-87324; E-3065; NAS 1.15:87324) Avail: NTIS HC A03/MF A01 CSCL 12B

Equations for a lumped parameter mathematical model of a subsonic wind tunnel circuit are presented. The equation state variables are internal energy, density, and mass flow rate. The circuit model is structured to allow for integration and analysis of tunnel subsystem models which provide functions such as control of altitude pressure and temperature. Thus the model provides a useful tool for investigating the transient behavior of the tunnel and control requirements. The model was applied to the proposed NASA Lewis Altitude Wind Tunnel (AWT) circuit and included transfer function representations of the tunnel supply/exhaust air and refrigeration subsystems. Both steady state and frequency response data are presented for the circuit model indicating the type of results and accuracy that can be expected from the model. Transient data for closed loop control of the tunnel and its subsystems are also presented, demonstrating the model's use as a control analysis tool. Author

N86-27037# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research and System Theory.
STOCHASTIC REALIZATION PROBLEMS MOTIVATED BY ECONOMIC MODELING
J. H. vanSchuppen Sep. 1985 20 p Revised Submitted for publication
(CWI-OS-R8507; B8577113; ESA-86-96989) Avail: NTIS HC A02/MF A01

The econometric modeling of time series as a stochastic realization problem (Kalman's approach) is introduced and, in a nondynamic framework, generalized to multivariate stochastic realization problems. The three-variate Gaussian stochastic realization problem is investigated. In a dynamic context the stochastic realization problem of representing an observed process such that the inherent causality or dependency relation between the components is made explicit is posed. ESA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N86-27038# Naval Postgraduate School, Monterey, Calif.
GAMMA PROCESSES
Peter A. W. Lewis, E. McKenzie, and D. K. Hugus Jan. 1986 37 p
(AD-A165390; NPS55-86-002) Avail: NTIS HC A03/MF A01 CSCL 12/1

The Beta Gamma transformation is described and is used to define a very simple first order autoregressive Beta Gamma process, BGAR(1). Maximum likelihood estimation is discussed for this model, as well as moment estimators. The first-order structure is extended to include moving average processes and mixed first-order autoregressive, pth-order moving average processes. It is shown that these Gamma processes are time-reversible and, therefore, too narrow for general physical modelling. A dual process to the BGAR(1) process, DBGAR(1), is introduced, as well as an iterated process which combines the Beta-Gamma process and the GAR(1) process of Gaver and Lewis (1980). Some properties of these extended autoregressive processes are derived. Several highly nonlinear extensions of these processes which produce negative correlation are given. GRA

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

N86-27039# Los Alamos National Lab., N. Mex.
KINETIC STABILIZATION OF FIELD-REVERSED CONFIGURATIONS
J. L. Schwarzmeier, H. R. Lewis, D. C. Barnes, and C. E. Seyler 1985 5 p Presented at the 7th US-Japan Workshop on Compact Toroids, Bellevue, Wash., 12-13 Nov. 1985 Prepared in cooperation with Cornell Univ., Ithaca, N.Y.
(Contract W-7405-eng-36)
(DE86-003655; LA-UR-85-4077; CONF-8511118-3) Avail: NTIS HC A02/MF A01

The tilt instability in field-reversed configurations (FRC's) may be roughly divided into two categories, depending on the nature of the unstable eigenfunction. The internal tilt instability, which could also be called an n = 1 ballooning mode, is defined here to be an instability in which the displacement of the flux surfaces is confined to the closed region of magnetic field and the separatrix remains fixed in time. Since, for a fixed separatrix, the only destabilizing term in delta W is proportional to the pressure gradient times the parallel curvature of the magnetic field, the internal tilt could be considered a pressure driven mode. The external tilt is defined here to be an instability in which the entire closed field line FRC rotates rigidly about some axis perpendicular to the symmetry axis of the FRC. The external tilt results from magnetic interactions involving the toroidal plasma current. In spheromaks (at zero beta) the tilt instability is due to these same interactions, so in this sense the external mode might be considered current driven. However, since in FRC's the toroidal current comes solely from having finite plasma pressure, the distinction between pressure and current driven instabilities in FRC's is not meaningful (there is no parallel current). For oblate FRC's the eigenfunction of the external tilt is a rigid rotation of the closed field line FRC. For FRC's that are only moderately prolate the distinction between internal and external tilt modes is not clear, and the eigenfunction of the tilt mode may be a combination of internal and external displacements of the flux surfaces. DOE

N86-27040# Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.
A PARADIGM FOR RELIABLE CLOCK SYNCHRONIZATION Interim Report
Fred B. Schneider Feb. 1986 22 p
(Contract N00014-86-K-0092; Grant NSF DCR-83-20274)
(AD-A164819; CU-CSD-TR-86-735) Avail: NTIS HC A02/MF A01 CSCL 09/2

Existing fault-tolerant clock synchronization protocols are shown to result from refining a single clock synchronization paradigm. In that paradigm, a reliable time source periodically issues messages that cause processors to resynchronize their clocks. The reliable time source is aproximated by reading all clocks in the system and using a convergence function to compute a fault-tolerant average of the values read. The performance of a clock synchronization algorithm based on the paradigm can be quantified in terms of the two parameters that characterize the behavior of the convergence function used: accuracy and precision. GRA

N86-27041# Massachusetts Inst. of Tech., Lexington.
EFFECT OF MAGNETOSTRICTION ON REMANENT MAGNETIZATION
Gerald F. Dionne 5 Dec. 1985 19 p refs
(Contract F19628-85-C-0002)
(AD-A165450; TR-737; ESD-TR-85-292) Avail: NTIS HC A02/MF A01 CSCL 20/3

Magnetostriction effects of remanent magnetization are examined in a phenomenological model that is used to design a high magnetization polycrystalline spinel ferrite with excellent square hysteresis loop properties. Isotropic magnetostriction is compensated by substituting Mn(3+) ions for 0.2 Fe(3+) ions per formula unit of Ni.65Zn.35Fe2O4 host material. As predicted by theory, the magnetostriction reduction dramatically increases the remanent magnetization and removes most of its external stress sensitivity. The resulting remanent magnetization, which approaches 4000 G, represents an increase of more than a factor of 2 over that of the host composition, with no significant deterioration in other magnetic and dielectric properties. The remanence ratio improvement is in general accord with estimates predicted by the theoretical model. GRA

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environment Pollution*.

N86-27042*# Michigan State Univ., East Lansing. Dept. of Mechanical Engineering.
TRANSVERSE VORTICITY MEASUREMENTS USING AN ARRAY OF FOUR HOT-WIRE PROBES
John F. Foss, Casey L. Klewicke, and Peter J. Disimile May 1986 147 p
(Grant NAG1-287)
(NASA-CR-178098; NAS 1.26:178098; FSFL-R-006) Avail: NTIS HC A07/MF A01 CSCL 20A

A comprehensive description of the technique used to obtain a time series of the quasi-instantaneous transverse vorticity from a four wire array of probes is presented. The algorithmic structure which supports the technique is described in detail and demonstration data, from a large plane shear layer, are presented to provide a specific utilization of the technique. Sensitivity calculations are provided which allow one contribution to the inherent uncertainty of the technique to be evaluated. Author

N86-27043*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PRESSURE PROBE AND HOT-FILM PROBE RESPONSES TO ACOUSTIC EXCITATION IN MEAN FLOW
Tony L. Parrott and Michael G. Jones (PRC Kentron, Inc., Hampton, Va.) Jun. 1986 56 p refs
(NASA-TP-2581; L-16079; NAS 1.60:2581) Avail: NTIS HC A04/MF A01 CSCL 20A

An experiment was conducted to compare the relative responses of a hot-film probe and a pressure probe positioned in a flow duct carrying mean flow and progressive acoustic waves.

The response of each probe was compared with that of a condenser-type microphone flush mounted in the duct wall for flow Mach numbers up to about 0.5. The response of the pressure probe was less than that of the flush-mounted microphone by not more than about 2.1 dB at the highest centerline Mach number. This decreased response of the probe can likely be attributed to flow-induced impedance changes at the probe sensor orifices. The response of the hot-film probe, expressed in terms of fluctuating pressure, was greater than that of the flush-mounted microphone by as much as 6.0 dB at the two higher centerline Mach numbers. Removal of the contribution from fluctuating temperature in the hot-film analytical model greatly improved the agreement between the two transducer responses. Author

N86-27044# Texas Univ., Austin. Applied Research Lab.
EXPERIMENTS ON SOUND PROPAGATION OVER SLOPED BOTTOMS Final Report, 1 Jul. 1983 - 30 Sep. 1984
Halvor Hobaek, Chris T. Tindle, and T. G. Muir 14 Nov. 1985 23 p
(Contract N00014-83-K-0593)
(AD-A163431; ARL-TR-85-41) Avail: NTIS HC A02/MF A01 CSCL 20/1

Experiments to study sound propagation in a shallow water wedge were conducted in a tank. Results confirm the assumption of adiabatic normal mode theory that the mode shapes adjust continuously to the local water depth. Mode coupling, if it exists, is negligible. For upslope propagation, the energy of a mode traveling beyond its cutoff depth is directed into the bottom with negligible coupling to lower modes. For downslope propagation, the normal modes in a wedge propagate with curved wavefronts and not with the straight vertical wavefronts of simple adiabatic normal mode theory. In addition, normal modes not present at the source can be captured when the water depth is sufficient to support them. GRA

N86-27045# Cornell Univ., Ithaca, N.Y. Dept. of Theoretical and Applied Mechanics.
X-RAY GENERATED ULTRASOUND Summary Report, 15 Apr. 1985 - 15 Jan. 1986
Wolfgang Sachse and Kwang Y. Kim 30 Jan. 1986 64 p refs
(Contract N00014-85-K-0263)
(AD-A164581; TAM-TR86-1) Avail: NTIS HC A04/MF A01 CSCL 20/1

This report describes the mechanisms by which ultrasonic signals are generated by an intense, pulsed X-ray source interacting with a material and how the associated contrast mechanisms can be used to image and characterize material microstructures. The existence of X-ray generated acoustic signals was verified and the beam-current dependence of the X-ray generated acoustic signals was established. The amplitudes of the acoustic signals appear to be linearly related to the electron beam current of the synchrotron and hence the X-ray intensity. Thus, the X-ray/acoustic phenomenon could form the basis of an X-ray beam monitor sensor. The X-ray acoustic signals were also found to depend linearly on the beam size. The generated X-ray/acoustic signals show a directivity pattern resembling that of the thermoelastic signals generated by a pulsed thermal laser source and they appear to be independent of beam width. A newly developed double modulation measurement technique analogous to existing photo-acoustic spectroscopy (PAS) measurements is described. It was found that the X-ray/acoustic spectra are material dependent. The measured scanned fields vary spatially, with features apparently related to the effects of the transducer or elastic wave resonances in the specimen. A preliminary test was completed with a new differential X-ray/acoustic measurement technique by which transducer and specimen wave propagation effects were removed so that spatial features in a specimen could be clealy identified. GRA

N86-27046# Washington Univ., Seattle. Applied Physics Lab.
COLOSSUS REVISITED: A REVIEW AND EXTENSION OF THE MARSH-SCHULKIN SHALLOW WATER TRANSMISSION LOSS MODEL (1962) Interim Report, 1 Aug. 1984 - 31 Jul. 1985
M. Schulkin and J. A. Mercer Dec. 1985 41 p refs
(Contract N00014-84-K-0646)
(AD-A164588; APL-UW-8508) Avail: NTIS HC A03/MF A01 CSCL 20/1

This report reviews the Marsh-Schulkin (M-S), or Colossus, model of acoustic transmission loss in shallow water in light of new information and techniques that have emerged since its introduction in 1962. The M-S model, a semiempirical model based on extensive measurements taken off the Atlantic Coast, uses several concepts; (1) refractive cycle, or skip distance; (2) deflection of energy into the bottomat high angles by scattering from the sea surface; and (3) a simplified Rayleigh two-fluid model of the bottom for sand or mud sediments. With a few free parameters, including water depth, about 100,000 measurements from 100 Hz to 10 kHz were fitted within stated error bounds. The chief criticisms of the model have been that it could not be adjusted for arbitrary negative sound-speed gradients, and that it uses empirical bottom loss values. The M-S model yields good predictions when applied properly; it is not to be used for all environments. The M-S model is compared with Rogers' semiempirical model based on numerical calculations of the normal-mode solutions to the wave equation for propagation in shallow water. The M-S model is also extended to treat arbitrary negative and bilinear sound-speed gradients by using new general expressions for skip distance, near-field anomaly, and reflection coefficients. The reflection coefficients are calculated from the Morse-Mackenzie relations for loss per bounce. GRA

N86-27047# Sierra Geophysics, Inc., Redmond, Wash.
MSS EVALUATION. REVISION 1 Status Report, 13 Aug. - 13 Nov. 1985
George R. Mellman and Marilee Henry 12 Feb. 1986 11 p refs
(Contract N00014-85-C-0793)
(AD-A164589) Avail: NTIS HC A02/MF A01 CSCL 08/11

This is a Marine seismic system (MSS) progress report. It discusses the following tasks: identify events detected and phases observed in MSS data; catalog pertinent MSS information and preliminary analysis; compare MSS and OBS data and site characteristics; analyze the Wake Island hydrophone array data. Preliminary findings suggest MSS detection threshold for unfiltered teleseismic events is rather high and that 180 regional events were recorded. GRA

N86-27048# Texas Univ., Austin. Applied Research Lab.
A SYNOPSIS OF RESEARCH ON SUBBOTTOM EFFECTS ON UNDERWATER ACOUSTIC PROPAGATION Final Report, 1 Jun. 1982 - 30 Sep. 1984
Robert A. Koch, Jo B. Lindberg, and Paul J. Vidmar 14 Nov. 1985 30 p
(Contract N00014-82-K-0679)
(AD-A165420; ARL-TR-85-40) Avail: NTIS HC A03/MF A01 CSCL 20/1

This report investigates some effects of the subbottom on underwater acoustic propagation. Our major accomplishment was solving the problem of ordering and counting the normal modes of propagation in the ocean waveguide when the seafloor is described by an impedance boundary condition. The boundary condition, derived from the plane wave reflection coefficient, introduces mathematical complexities since it is a function of the separation parameter in the acoustic wave equation. As a natural extension of our theoretical approach, the relationship between mode concepts of normalization and cycle distance, and geometrical ray concepts of beam displacement and time delay were rigorously established. Additional work was also done to examine ray and normal mode approaches for predicting propagation in a sloping geometry. GRA

N86-27049# Miami Univ., Fla. School of Marine and Atmospheric Science.
ACOUSTIC NORMAL MODES USING THE PROPAGATOR MATRIX TECHNIQUE FOR A STRATIFIED OCEAN OVERLAYING AN INHOMOGENEOUS ANISOTROPIC POROUS BED Interim Report

Mohsen Badiey and Tokuo Yamamoto Jan. 1986 116 p
(Contract N00014-85-C-0020)
(AD-A165436; AD-F250510; RSMAS-TR86-002) Avail: NTIS HC A06/MF A01 CSCL 17/1

Propogation of acoustic normal modes at excitation frequencies of 50 to 50000 Hz in a shallow stratified ocean overlaying a transverse isotropic poro-elastic sediment bed is modeled. The Biot-Willis stiffness matrix of the poro-elastic anisotropy is defined in terms of physical properties of sediments to model the bed. Propagator matrix method is used to solve the differential equations for the motion stress vectors in both layered sediment and water. The effects of sediment properties on the dispersion and attenuation of acoustic waves are examined numerically. Using the relaxation principle it is observed that the energy loss is maximum at frequency referred to as relaxation frequency of the porous media given by f sub ri = (beta)(nu)/3 pi k (sub si), where beta is the porosity, nu is the kinematic viscosity of the pore fluid and k (sub si) is the anisotropic permeability coefficient. The phase speed of compressional and shear waves in the sediment becomes highly dispersive around this frequency. The sandy bottom's relaxation frequency is the range of several hundred hertz to several kilo hertz. This report presents the derivation of the mathematical expressions used in the model and a complete description of the computer program. Four examples of numerical calculations are provided. GRA

N86-27050# Ohio State Univ., Columbus. Dept. of Welding Engineering.
INVESTIGATIONS OF ULTRASONIC WAVE INTERACTIONS AT BOUNDARIES SEPARATING ANISOTROPIC MATERIALS Progress Report
L. Adler Nov. 1985 7 p
(Contract DE-FG02-84ER-45057)
(DE86-004953; DOE/ER-45057/1) Avail: NTIS HC A02/MF A01

The studies of the interaction of waves with interfaces between generally anisotropic media were supported experimentally. Two boundary conditions on the interface were considered: rigid, and slip. The latter boundary condition describes dislocation boundaries and slip on grain boundaries. It was shown that reflection from such an interface is much stronger than from a rigid bond. A device was designed based on the diffraction of waves on periodic gratings. An anomalous phenomenon was found in the reflection of elastic waves from an interface between anisotropic crystals. It was found that the domain of permissible incident angles splits into disjoint pieces for certain crystal cuts. In this way, a new branch for the reflection coefficient was found. A sample from a Ni crystal was prepared. Another experiment was carried out on critical angles in backscattering. The general computer programs are being adapted to interactive algorithms for the PDP-11 with real time plotting of results on graphic displays. The Schlieren Visualization System was improved by adding capabilities for visualization of impulse ultrasonic signals. DOE

N86-27051# Kema N.V., Arnhem (Netherlands). Dept. of Physical Research.
CONTINUOUS ULTRASONIC WAVES TO DETECT STEAM BUBBLES IN WATER UNDER HIGH PRESSURE
H. J. M. Hulshof, F. Schurink, and A. J. vanLoon, ed. 1985 13 p Information brochure presented at 2nd UN Conf. on the Exploration and Peaceful Uses of Outer Space (UNISPACE), Vienna, Aug. 1982 -12 Nov. 1985 Sponsored by Netherlands Central Organization TNO, Delft, Gals, Switzerland and Energy Research Laboratory
(S/T-Rept-Vol-3-No-5; B8574250; ISBN-90-353-0028-9; ISSN-0167-8590; ESA-86-96944) Avail: NTIS HC A02/MF A01

A detector using continuous ultrasonic waves to detect bubbles in water in steel tubes is described. The variation of the transmitted wave caused by the bubbles was determined by demodulation. The results meet the objectives set for cold water with air bubbles. A clear indication of the presence of steam bubbles is found in fast-flowing hot water in a steel tube with a diameter of 60 mm. A change in the low-frequency region of the modulation is the only indication of the presence of steam bubbles in the large-diameter downcomer of the water-separator drum of a boiler in an electrical power plant. Possible causes of the differences in the results obtained are discussed on the basis of differences in bubble sizes, and in focusing and reflection of the ultrasonic waves. ESA

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N86-27052# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Physics.
THEORY OF PHOTO- AND ELECTROPRODUCTION OF MESONS: PROBLEMS AND PROSPECTS
N. C. Mukhopadhyay, R. Davidson, M. Bourdeau, S. Nergiz, and R. Wittman 1985 27 p refs
(Contract DE-AC02-83ER-40114)
(DE86-004094; DOE/ER-40114/T2) Avail: NTIS HC A03/MF A01

The state of theoretical understandings of the photo- and electroproduction of pions from nucleons is reviewed, with particular emphasis on the unitarity and dynamics. Understandings of these processes in the delta region are summarized, with emphasis on the hadron structure. Some problems and prospects for future studies of the high-energy photo- and electroproduction of mesons at CEBAF are discussed. DOE

N86-27053# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
QUASI-PARTICLE SPECTRUM OF THE HUBBARD MODEL
Ram Kishore Apr. 1986 24 p Submitted for publication
(INPE-3869-PRE/927) Avail: NTIS HC A02/MF A01

The quasi-particle spectrum of the Hubbard model is studied by using a projection operator formalism of the Green's function. In weak electron correlation regime, the exact results are obtained up to the second order in the intra-atomic interaction. For strong electron correlations, the quasi-particle spectrum consists of two bands. For each band, quasi-particle energy is obtained exactly up to the first order in the transfer integral. Also, a semiclassical approximation is proposed which gives the above mentioned exact results in proper limits. Author

N86-27054# Illinois Inst. of Tech., Chicago. Dept. of Physics.
THEORETICAL ELEMENTARY PARTICLE STUDIES Final Report, Sep. 1983 - Jul. 1985
J. C. Collins 1985 8 p
(Contract DE-AC02-80ER-10712)
(DE86-001165; DOE/ER-10712/5) Avail: NTIS HC A02/MF A01

The work done during the period September 1983 to July 1985 covers several areas of the theory of the strong interactions of elementary particles, mostly in the area characterized as perturbative QCD. The specific topics are: the proof of factorization for hard processes, such as the Drell-Yan process; calculation of transverse-momentum distributions for these processes; investigation of the small-x region; demonstration of the applicability of perturbative QCD (quantum chromodynamics) to the production of heavy quarks; and improved methods of calculation of the effects of heavy quarks in hard processes, and in particular of their distribution functions in hadrons (structure functions). DOE

N86-27055*# National Aeronautics and Space Administration. Pasadena Office, Calif.
VARIABLE ENERGY, HIGH FLUX, GROUND-STATE ATOMIC OXYGEN SOURCE Patent Application
Ara Chutjian, Inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) and Otto J. Orient, Inventor (to NASA) Filed 10 Apr. 1986 17 p Sponsored by NASA
(NASA-Case-NPO-16640-1-CU; NAS 1.71:NPO-16640-1-CU; US-Patent-Appl-SN-852468) Avail: NTIS HC A02/MF A01 CSCL 20H

A variable energy, high flux atomic oxygen source is described which is comprised of a means for producing a high density beam of molecules which will emit O(-) ions when bombarded with

electrons; a means for producing a high current stream of electrons at a low energy level passing through the high density beam of molecules to produce a combined stream of electrons and O(-) ions; a means for accelerating the combined stream to a desired energy level; a means for producing an intense magnetic field to confine the electrons and O(-) ions; a means for directing a multiple pass laser beam through the combined stream to strip off the excess electrons from a plurality of the O(-) ions to produce ground-state O atoms within the combined stream; an electrostatic deflection means for deflecting the path of the O(-) ions and the electrons in the combined stream; and a means for stopping the O(-) ions and the electrons and for allowing only the ground-state O atoms to continue as the source of the atoms of interest. The method and apparatus are also adaptable for producing other ground-state atoms and/or molecules. NASA

N86-27056# State Univ. of New York, Buffalo. Dept. of Chemistry.
RESONANCE FLUORESCENCE OF A TWO-LEVEL ATOM NEAR A ROUGH METAL SURFACE Interim Technical Report
Xi-Yi Huang, Ki-Tung Lee, and Thomas F. George Jan. 1986 33 p
(Contract N00014-86-K-0043)
(AD-A163219; URochester/DC/85/TR-4) Avail: NTIS HC A03/MF A01 CSCL 07/5

Surface-dressed optical Bloch equations are solved for a two-level atom near or adsorbed on a rough surface, which is modeled as a hemispheroid protrusion on a perfectly-conducting surface. Effects of the laser bandwidth are included by means of a phase-diffusion model. The presence of the surface roughness generates a dephasing broadening mechanism on the adatomic resonance fluorescence spectrum, which can be strongly enhanced by plasma resonances depending on the shape of the hemispheroid. The dependence of the electrodynamics of the adatom on the adatom-hemispheroid distance is also evaluated. GRA

N86-27057# Yeshiva Univ., New York, N. Y.
ION TRANSPORT ACROSS SYNTHETIC AND BIOLOGICAL MEMBRANES: IONOPHORE-MEDIATED TRANSPORT Final Report, May 1982 - Sep. 1985
Lea Elau 21 Oct. 1985 19 p
(Contract N00014-82-K-0437)
(AD-A163269; AD-E500743) Avail: NTIS HC A02/MF A01 CSCL 06/16

The objectives of this study were: to set-up a research laboratory; to initiate membrane related research; to investigate ionophore-mediated transport and to involve students in research. Synthetic compounds, the lariat ethers, and a non-cyclic di-n-propyl diamide were investigated. These compounds were known to form complexes with cations in organic solvents. However, their ionophoretic activity in model membranes has not been previously demonstrated. It was shown that some lariat ethers mediate potassium transport across phosphatidylcholine bilayers, and that the diamide induced calcium movement across lipid membranes. The polyether carboxylic acids A23187 and X537A were extensively investigated. The inital rates of calcium movement across lipid bilayers were measured as a function of the ionophore and calcium concentration. It has been found that the transported complex has a stoichiometry of ionophore:calcium 2:1 and 1:1 for A23187 and X537A respectively. However, esterification of the carboxylic group of A23187 to yield the appropriate methyl ester reduced the potency more than 200 fold and the stoichiometry was changed to ionophore:calcium 1:1. GRA

N86-27058# Colorado State Univ., Fort Collins. Dept. of Chemistry.
CALCULATIONS OF THE GEOMETRY AND BINDING ENERGY OF AROMATIC DIMERS: BENZENE, TOLUENE, AND TOLUENE-BENZENE
Mark Schauer and E. R. Bernstein 15 Apr. 1985 26 p refs
(Contract N00014-79-C-0647)
(AD-A164570; TR-17) Avail: NTIS HC A03/MF A01 CSCL 20/8

Calculations of the geometries and energies of the benzene, toluene, and toluene-benzene dimers using a combination of atom-atom and multipolar potentials are presented and discussed. An exponential-six atom-atom potential plus a molecular quadrupole-quadrupole interaction term gives the reported parallel displaced C2h benzene dimer geometry. The excited state behavior of the benzene dimer can be qualitatively understood based on this calculation. The toluene-benzene dimer is well modeled by these terms in addition to a dipole-quadrupole interaction term. Both parallel displaced and perpendicular configurations are obtained in agreement with the experimental data. Using exponential-six, dipole-dipole, quadrupole-quadrupole, and dipole-quadrupole interactions the toluene dimer can be satisfactorily modeled. The calculations generally suggest that excitation of parallel displaced dimers can lead to rearrangement (and possible excimer formation) in the excited state. GRA

N86-27059# Naval Research Lab., Washington, D. C.
THE USE OF ION IMPLANTATION FOR MATERIALS PROCESSING Annual Progress Report, 1 Oct. 1983 - 30 Sep. 1984
F. A. Smidt 6 Mar. 1986 241 p
(AD-A165432; AD-F250510; NRL-MR-5716) Avail: NTIS HC A11/MF A01 CSCL 13/8

This report is the sixth in a series of Progress Reports on work conducted at the Naval Research Laboratory (NRL) to investigate the use of ion implantation for materials processing. The objective of the program is to develop the capabilities of ion implantation and ion beam activated deposition for new and improved surface treatment techniques of interest to Navy and DOD applications. Attainment of this objective requires both fundamental research to provide an understanding of the physical and metallurgical changes taking place in the implanted region of a material and applications oriented research to demonstrate the benefits of ion implantation. The purpose of this report is to make available from one source the results of all studies at NRL related to the use of ion implantation for materials processing so as to provide a more comprehensive picture of the scope and interrelationship of the research and to expedite technology transfer to the civilian industrial sector. The report consists of four sections describing the research and a cummulative bibliography of published papers and reports. This report describes the important factors in ion implantation science and technology and reports progress in the use of ion implantation to modify friction, wear, fatigue, corrosion, optical and magnetic properties of materials. GRA

N86-27060# California Univ., Berkeley. Lawrence Berkeley Lab.
REACTION DYNAMICS OF ELECTRONICALLY EXCITED ALKALI ATOMS WITH SIMPLER MOLECULES
P. S. Weiss, J. M. Mestdagh, H. Schmidt, M. F. Vernon, M. H. Covinsky, B. A. Balko, and Y. T. Lee May 1985 14 p Presented at the Conference on Recent Advances in Molecular Reaction Dynamics, Aussois, France
(Contract DE-AC03-76SF-00098)
(DE85-014538; LBL-19719; CONF-8506151-1) Avail: NTIS HC A02/MF A01

The reactions of electronically excited sodium atoms with simple molecules have been studied in crossed molecular beams experiments. Electronically excited Na(3(2)P(sub 3/2), 4(2)D(sub 5/2), and 5(2)S(sub 1/2) were produced by optical pumping using single frequency dye lasers. The effects of the symmetry, and the orientation and alignment of the excited orbital on the chemical reactivity, and detailed information on the reaction dynamics were derived from measurements of the product angular and velocity distributions. DOE

N86-27061# Brookhaven National Lab., Upton, N. Y.
FASTRUN: A HIGH PERFORMANCE COMPUTING DEVICE FOR MOLECULAR MECHANICS USING A PIPELINE ARCHITECTURE
D. G. Dimmler, R. Fine, and C. Levinthal Oct. 1985 7 p Presented at the IEEE Nuclear Science Symposium, San Francisco, Calif.,

23 Oct. 1985 Prepared in cooperation with Columbia Univ., New York
(Contract DE-AC02-76CH-00016)
(DE86-004355; BNL-37221; CONF-851009-41) Avail: NTIS HC A02/MF A01

A deep, synchronous pipeline architecture has been selected for a computing device with a power of 500 million floating point operations per second (Mflops). The device calculates the forces and energy due to pair-wise interactions of many objects in a system. Considerations relating to application specific high-performance computer architectures are addressed. In addition, topics specifically relating to very deep, synchronous unidirectional pipelines are discussed. A key element of the device, a quadratic interpolator based on a lookup table, has been developed and tested. Five of these interpolators with a total computing power of 280 Mflops will be employed in the device. DOE

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N86-27062# Los Alamos National Lab., N. Mex.
WAKEFIELD ACCELERATORS FOR SDI
M. E. Jones, R. Keinigs, R. J. Faehl, and B. G. DeVolder 1985 6 p refs Presented at the Compact Accelerator Workshop/ Conference, Livermore, Calif., 23-24 Oct. 1985
(Contract W-7405-eng-36)
(DE86-003673; LA-UR-85-3999; CONF-8510203-3) Avail: NTIS HC A02/MF A01

The Wakefield accelerator concept consists of utilizing the electric field generated by the motion of one group of particles to accelerate another group of particles. Essentially, the Wakefield accelerator is a transformer which transfers the energy in a large number of relatively low energy particles to a smaller number of particles, resulting in acceleration of these particles to high energy. The basic physics of Wakefield acceleration is described, and issues relevant to SDI applications. For such applications the amount of total energy in the beam must be maximized. Specific Wakefield concepts are described - RF cavity and slow-wave structure Wakefield and the plasma Wakefield accelerator. DOE

N86-27063*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OPTICAL MODEL CALCULATIONS OF HEAVY-ION TARGET FRAGMENTATION
Lawrence W. Townsend, John W. Wilson, Francis A. Cucinotta (Old Dominion Univ., Norfolk, Va.), and John W. Norbury Jul. 1986 15 p refs
(NASA-TM-87692; L-16113; NAS 1.15:87692) Avail: NTIS HC A02/MF A01 CSCL 20H

The fragmentation of target nuclei by relativistic protons and heavy ions is described within the context of a simple abrasion-ablation-final-state interaction model. Abrasion is described by a quantum mechanical formalism utilizing an optical model potential approximation. Nuclear charge distributions of the excited prefragments are calculated by both a hypergeometric distribution and a method based upon the zero-point oscillations of the giant dipole resonance. Excitation energies are estimated from the excess surface energy resulting from the abrasion process and the additional energy deposited by frictional spectator interactions of the abraded nucleons. The ablation probabilities are obtained from the EVA-3 computer program. Isotope production cross sections for the spallation of copper targets by relativistic protons and for the fragmenting of carbon targets by relativistic carbon, neon, and iron projectiles are calculated and compared with available experimental data. Author

N86-27064# Wisconsin Univ., Madison. Dept. of Nuclear Engineering.
FUSION REACTOR PHYSICS AND TECHNOLOGY STUDIES Final Report, 1 Oct. 1977 - 30 Nov. 1985
G. L. Kulcinski, G. A. Emmert, C. W. Maynard, R. W. Conn, J. F. Santarius, I. N. Sviatoslavsky, and M. E. Sawan Nov. 1985 15 p
(Contract DE-AC02-78ET-52048)
(DE86-004527; DOE/ET-52048/32) Avail: NTIS HC A02/MF A01

A brief review of seven reactor studies is given. The studies which are listed are NUWAK, INTOR, WITAMIR-I, UWTOR-M, MARS, and MINIMARS. A list of 133 reports which were issued under Fusion Reactor Physics and Technology Studies is given for further consideration of the above studies. DOE

N86-27065# Brookhaven National Lab., Upton, N. Y.
PARTICLE DYNAMICS FOR MOTION IN A NON-PLANAR ACCELERATOR
A. Antillon and M. Month 20 Aug. 1985 28 p
(Contract DE-AC02-76CH-00016)
(DE86-005303; BNL-51927) Avail: NTIS HC A03/MF A01

The basic dynamics of a planar accelerator is extended to the non-planar case. This is done using the geometrical concept of torsion and extending the Hamiltonian formalism. A generalized non-planar reference orbit is adopted which introduces torsion in appropriately chosen drift spaces. The parameters of the reference orbit are associated with uncoupled and coupled betatron parameters currently in use. DOE

N86-27066# Kema N.V., Arnhem (Netherlands). Dept. of Reactor Physics.
MELTING NUCLEAR FUEL
C. D. Andriesse and A. J. vanLoon, ed. 1985 25 p
(S/T-Rept-Vol-3-No-7; B8575584; ISBN-90-353-0030-0; ISSN-0167-8590; ESA-86-96946) Avail: NTIS HC A02/MF A01

Transport of fission products in overheated reactor fuel is discussed. The relevance of this transport for the determination of the source term at severe accidents with a nuclear reactor is outlined. Experimental data on the release of fission products from UO2 at high temperatures are analyzed. A model explaining these data in terms of basic transport processes is applied to predict releases at accidents, and is compared to releases measured in tests with severe damage of fuel or calculated in core-melt studies. It appears that the behavior of nonvolatile fission products needs further study. Assumptions and approximations in the model are reviewed. Release is described as a result of intragranular diffusion, either in an interstitial mode (for unbound fission products) or in a substitutional mode (for bound products). A theory for the diffusion entropy of the interstitial mode is provided. ESA

N86-27067# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Geotechnical Lab.
ALTERNATIVE METHODS FOR DISPOSAL OF LOW-LEVEL RADIOACTIVE WASTES
R. D. Bennett Oct. 1985 102 p
(Contract NRC-FIN-D1001)
(TI81-900254; NUREG/CR-3775-Vol-5) Avail: NTIS HC A06/MF A01

Current practice in the U. S. for disposal of commercial low level radioactive wastes (LLW) is burial in shallow trenches. Although shallow land burial in trenches may continue to be practiced, it is likely that techniques for engineered disposal will be introduced to the National Regulatory Commission or states for licensing consideration within the next few years. The shaft disposal alternative is one of several methods that may be proposed. The term shaft disposal refers to a near surface disposal alternative in which the wastes would be disposed of in shafts or boreholes augered, bored, or sunk by any other conventional method. A generic description of the features, components, and operation of a shaft disposal facility is provided. Features and components that could enhance the long term performance are also described, including site conditions for which they would be

applicable. The existing criteria developed for near surface disposal were assessed for applicablility to the shaft disposal method. B.G.

74 OPTICS

Includes light phenomena.

N86-27068# Department of the Air Force, Washington, D.C.
FIBER OPTIC CABLE STORAGE DEVICE Patent Application
Gregory J. Zagar, inventor (to Air Force) Filed 18 Dec. 1985 14 p
(AD-D012166; US-Patent-Appl-SN-810432) Avail: NTIS HC A02/MF A01 CSCL 20/6

This patent application discloses a fiber optic cable storage device for securing fiber optic cable with connectors on a spool. The spool includes a drum with a flange and slot that allows for stress free routing of cable and connectors to a connector storage area. The connector storage area includes a drive plate for mechanically reeling of the cable and connector holders for holding fiber optic cable connectors. A removable cover is used to trap the cable connectors in the holders. GRA

N86-27069# Optical Society of America, Washington, D. C.
TOPICAL MEETING ON PICOSECOND ELECTRONICS AND OPTOELECTRONICS: A DIGEST OF TECHNICAL PAPERS
15 Mar. 1985 137 p refs Presented at the Topical Meeting on Picosecond Electronics and Optoelectronics, Incline Village, Nev., Mar. 13-15 1985
(AD-A164598) Avail: NTIS HC A07/MF A01 CSCL 20/6

The following subjects were discussed at a meeting on picosecond electronics and optoelectronics held at Incline Village, Nevada, March 13 to 15, l985: Ultrafast Optics and Electronics I, Ultrafast Optics and Electronics II, High-Speed Phenomena in Semiconductors, Picosecond Diode Lasers, Poster Session, Optoelectronics, Cryoelectronics, Ultrafast Electronics, Quantum Structures, and Electronics and Optoelectronics. GRA

N86-27070# Colorado Univ., Boulder.
A BRILLOUIN LIGHT SCATTERING STUDY OF MAGNETIC EXCITATIONS Final Report, 1 Apr. 1981 - 15 Oct. 1985
Carl E. Patton 30 Jan. 1986 16 p
(Contract MIPR-ARO-119-83; Grant NSF DMR-80-13727)
(AD-A164716; ARO-17591-17-PH) Avail: NTIS HC A02/MF A01 CSCL 20/6

Of particular note are results on exchange in Li-Zn ferrite and surface magnons in thin films. Central to the research was the development of a high contrast, high resolution multipass tandem Fabry-Perot interferometer. The 4-plus-2 system has a contrast in excess of 10 to the 12th power and a background dark count below 1/3 count/second. GRA

N86-27071# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
FIELD-SEQUENTIAL COLOR STEREOSCOPY WITH LIQUID CRYSTAL SPECTACLES
P. Milgram and R. vanderHorst 8 Jun. 1984 9 p Presented at 4th International Display Research Conference (Eurodisplay) '84), Paris, France, 18-20 Sep. 1984
(NLR-MP-84081-U; B8577051; ESA-86-96971) Avail: NTIS HC A02/MF A01

A field-sequential stereoscopic display using the phase change effect with cholesteric liquid crystals is presented. Advantages, especially with respect to PLZT shutters, include minimal reduction in image brightness, full color, and reduced visual fatigue. ESA

N86-26804# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
FLIR, NVG AND HMS/D SYSTEMS FOR HELICOPTER OPERATION: REVIEW
H.-D. V. Boehm *In* AGARD Visual Protection and Enhancement Dec. 1985 27 p refs (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

N86-26808# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
NIGHT VISION SUPPORT DEVICES: HUMAN ENGINEERING INTEGRATION
Louis V. Genco *In* AGARD Visual Protection and Enhancement Dec. 1985 8 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

N86-26811# Marconi Avionics Ltd., Rochester (England). Airborne Display Div.
NIGHT VISION BY NVG WITH FLIR
G. C. Bull *In* AGARD Visual Protection and Enhancement Dec. 1985 7 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

N86-26820# WWDBw ABC-Schutz, Munster (West Germany).
GERMAN DEVELOPMENT OF A LC-FLASHBLINDNESS DEVICE
W. Rehmann and H. Sesterhenn *In* AGARD Visual Protection and Enhancement Dec. 1985 6 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

N86-26824# British Aerospace Public Ltd. Co., Kingston-upon-Thames (England). Systems Engineering Dept.
VISUAL DIFFICULTIES ASSOCIATED WITH FUTURE WINDSCREEN AND HUD INTEGRATION
A. J. Hulme and K. F. Shrubb *In* AGARD Visual Protection and Enhancement Dec. 1985 9 p (For primary document see N86-26802 17-52)
Avail: NTIS HC A11/MF A01

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N86-27072# Lawrence Livermore National Lab., Calif.
PLASMA PHYSICS MODELING AND THE CRAY-2 MULTIPROCESSOR
J. Killeen 1985 12 p refs Presented at the 7th International Conference on Computing Methods in Applied Sciences and Engineering, Versailles, France, 9-13 Dec. 1985 Submitted for publication
(Contract W-7405-eng-48)
(DE86-004239; UCRL-93699; CONF-851251-1) Avail: NTIS HC A02/MF A01

The importance of computer modeling in the magnetic fusion energy research program is discussed. The need for the most advanced supercomputers is described. To meet the demand for more powerful scientific computers to solve larger and more complicated problems, the computer industry is developing multiprocessors. The role of the Cray-2 in plasma physics modeling is discussed with some examples. DOE

N86-27073# Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.
NON-THERMAL ELECTRON VELOCITY DISTRIBUTION MEASURED BY ELECTRON CYCLOTRON EMISSION IN ALCATOR C TOKAMAK
K. Kato and I. H. Hutchinson Oct. 1985 15 p refs
(Contract DE-AC02-78ET-51013)
(DE86-004402; PFC/JA-85-37) Avail: NTIS HC A02/MF A01

The non-thermal electron velocity distribution of lower hybrid RF heated plasmas in the Alcator C tokamak is deduced from measurements of electron cyclotron emission using a specialized vertical viewing optics arrangement. At a density of anti n(sub e) = 0.7 × 10 to the 29th power/cu m, the reconstructed

distribution function in the range 50keV less than or equal to E less than or equal to 230keV shows enhancement in the parallel direction with a perpendicular spread equivalent to T(sub perpendicular) approx. = 30keV. The line average energetic electron density in this energy range is approximately 7 x 10 to the 15th power/cu m during the RF. DOE

N86-27074# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ELECTRON BERNSTEIN WAVE CURRENT DRIVE IN THE START-UP PHASE OF A TOKAMAK DISCHARGE
A. Montes and G. O. Ludwig 2 Jul. 1986 20 p Submitted for publication
(INPE-3868-PRE/926) Avail: NTIS HC A02/MF A01

Current drive by electron Bernstein waves in the start-up phase of tokamak discharges is studied. A general analytical expression is derived for the figure of merit J/P sub d associated with these waves. This is coupled with a ray tracing code, allowing the calculation of the total current generated per unit incident power in realistic tokamak conditions. The results show that electron Bernstein waves can drive substantial currents even at very low electron temperature. Author

N86-27075*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
IN SITU MEASUREMENTS OF THE PLASMA BULK VELOCITY NEAR THE IO FLUX TUBE
Alan Barnett Oct. 1985 43 p refs Sponsored by JPL, Pasadena, Calif.
(NASA-CR-176810; NAS 1.26:176810; CSR-P-85-6) Avail: NTIS HC A03/MF A01 CSCL 20I

The flow around the Io flux tube was studied by analyzing the eleven spectra taken by the Voyager 1 Plasma Science (PLS) experiment in its vicinity. The bulk plasma parameters were determined using a procedure that uses the full response function of the instrument and the data in all four PLS sensors. The mass density of the plasma in the vicinity of Io is found to be 22,500 + or - 2,500 amu/cu cm and its electron density is found to be 1500 + or - 200/cu cm. The Alfven speed was determined using three independent methods; the values obtained are consistent and taken together yield V sub A = 300 + or - 50 km/sec, corresponding to an Alfven Mach number of 0.19 + or - 0.02. For the flow pattern, good agreement was found with the model of Neubauer (1980), and it was concluded that the plasma flows around the flux tube with a pattern similar to the flow of an incompressible fluid around a long cylinder obstacle of radius 1.26 + or - 0.1 R sub Io. Author

N86-27076*# Massachusetts Inst. of Tech., Cambridge.
THE RESPONSE FUNCTION OF MODULATED GRID FARADAY CUP PLASMA INSTRUMENTS
Alan Barnett and Stanislaw Olbert 1986 37 p refs Submitted for publication
(Grant NsG-22-009-015)
(NASA-CR-177312; NAS 1.26:177312; CSR-P-85-5) Avail: NTIS HC A03/MF A01 CSCL 20I

Modulated grid Faraday cup plasma analyzers are a very useful tool for making in situ measurements of space plasmas. One of their great attributes is that their simplicity permits their angular response function to be calculated theoretically. An expression is derived for this response function by computing the trajectories of the charged particles inside the cup. The Voyager Plasma Science (PLS) experiment is used as a specific example. Two approximations to the rigorous response function useful for data analysis are discussed. The theoretical formulas were tested by multi-sensor analysis of solar wind data. The tests indicate that the formulas represent the true cup response function for all angles of incidence with a maximum error of only a few percent. Author

N86-27077# Naval Research Lab., Washington, D. C.
HIGH POWER MICROWAVE PLASMA PULSE COMPRESSION Memorandum Report, Oct. 1984 - Oct. 1985
W. M. Manheimer and B. H. Ripin 31 Dec. 1985 35 p
(AD-A163298; NRL-MR-5589) Avail: NTIS HC A03/MF A01 CSCL 20/14

It is shown that a plasma loaded waveguide is sufficiently dispersive that very high power microwave pulse compression is possible. The input microwave pulse can be either chirped or fixed frequency, if the waveguide plasma parameters are steady or variable in time respectively. GRA

N86-27078# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
WHISTLER-MODE RADIATION FROM THE SPACELAB 2 ELECTRON BEAM Progress Report
D. A. Gurnett, W. S. Kurth, J. T. Steinberg, P. M. Banks, and R. I. Bush 27 Nov. 1985 23 p
(Contract N00014-85-K-0404)
(AD-A163367; U-Of-Iowa-85-19) Avail: NTIS HC A02/MF A01 CSCL 22/1

During the Spacelab 2 mission the Plasma Diagnostics Package (PDP) performed a fly-around of the shuttle at distances of up to 300 meters while an electron beam was being ejected from the shuttle. This paper discusses a magnetic conjunction of the shuttle and the PDP while the electron gun was operating in a steady (DC) mode. During this conjunction the PDP detected a very clear funnel-shaped emission that is believed to be caused by whistler-mode emission from the beam. Ray path calculations show that the shape of the funnel can be accounted for by whistler-mode waves propagating near the resonance cone. Since the beam and waves are propagating in the same direction, the radiation must be produced by a Landau, omega(k parallel) = V sub b, interaction with the beam. Other types of waves generated by the beam are also described. GRA

N86-27079# Lawrence Livermore National Lab., Calif.
MONTE CARLO PARTICLE SIMULATION AND FINITE-ELEMENT TECHNIQUES FOR TANDEM MIRROR TRANSPORT
T. D. Rognlien, B. I. Cohen, Y. Matsuda, and J. J. Stewart, Jr. Dec. 1985 10 p Presented at the US-Japan Workshop on Advanced Plasma Modeling, Nagoya, Japan, 24 Sep. 1985
(Contract W-7405-eng-48)
(DE86-004238; UCRL-93686; CONF-8509216-1) Avail: NTIS HC A02/MF A01

A description is given of numerical methods used in the study of axial transport in tandem mirrors owing to Coulomb collisions and RF diffusion. The methods are Monte Carlo particle simulations and direct solution to the Fokker-Planck equations by finite-element expansion. DOE

N86-27080# Oak Ridge National Lab., Tenn.
FEATURES OF SPHERICAL TORUS PLASMAS
Y. K. M. Peng and D. J. Strickler Dec. 1985 32 p
(Contract DE-AC05-84OR-21400)
(DE86-004642; ORNL/FEDC-85/6) Avail: NTIS HC A03/MF A01

The spherical torus is a very small aspect ratio (A less than 2) confinement concept obtained by retaining only the indispensable components inboard to the plasma torus. MHD equilibrium calculations show that spherical torus plasmas with safety factor q greater than 2 are characterized by high toroidal beta ((BETA)/sub t/ greater than 0.2), low poloidal beta ((BETA)/sub p/ less than 0.3), naturally large elongation (kappa greater than or equal to 2), large plasma current with I/sub p//(aB/sub t0/) up to about 7 MA/mT, strong paramagnetism (B/sub t//B/sub t0/ greater than 1.5), and strong plasma helicity (F comparable to THETA). A large near-omnigeneous region is seen at the large-major-radius, bad-curvature region of the plasma in comparison with the conventional tokamaks. These features combine to engender the spherical torus plasma in a unique physics regime which permits compact fusion at low field and modest cost. Because of its strong paramagnetism and helicity, the spherical torus plasma shares some of the desirable features of spheromak and reversed-field pinch (RFP) plasmas, but with tokamak-like confinement and safety factor q. The general class of spherical tori, which includes the spherical tokamak (q greater than 1), the spherical pinch (1 greater

than q greater than O), and the spherical RFP (q less than O), have magnetic field configurations unique in comparison with conventional tokamaks and RFPs. DOE

N86-27081# Oak Ridge National Lab., Tenn.
HIGHLIGHTS FROM THE ASSEMBLY OF THE HELICAL FIELD COILS FOR THE ADVANCED TOROIDAL FACILITY
R. D. Benson 1985 4 p Presented at the 11th Symposium on Engineering Problems in Fusion Research, Austin, Tex., 18 Nov. 1985
(Contract DE-AC05-84OR-21400)
(DE86-004758; CONF-851102-59) Avail: NTIS HC A02/MF A01

The helical field (HF) coils in the Advanced Toroidal Facility (ATF) device consist of a set of 24 identical segments connected to form a continuous pair of helical coils wrapped around a toroidal vacuum vessel. Each segment weighs approximately 1364 kg (3000 lb) and is composed of 14 water-cooled copper plate conductors bolted to a cast stainless steel structural support member with a T-shape cross section (known as the structural tee). The segment components are electrically insulated with Kapton adhesive tape, G-10, Tefzel, and rubber to withstand 2.5 kV. As a final insulator and structural support, the entire segment is vacuum impregnated with epoxy. This paper offers a brief overview of the processes used to assemble the component parts into a completed segment, including identification of items that required special attention. DOE

N86-27082# Martin Marietta Energy Systems, Inc., Oak Ridge, Tenn.
ADVANCED TOROIDAL FACILITY
R. L. Johnson 1985 4 p Presented at the 11th Symposium on Engineering Problems in Fusion Research, Austin, Tex., 18 Nov. 1985
(Contract DE-AC05-84OR-21400)
(DE86-004805; CONF-851102-57) Avail: NTIS HC A02/MF A01

The Advanced Toroidal Facility (ATF) is a new magnetic confinement plasma device under construction at the Oak Ridge National Laboratory (ORNL) that will lead to improvements in toroidal magnetic fusion reactors. The ATF is a type of stellerator, known as a torsatron, which theoretically has the capability to operate at greater than or equal to 8% beta in steady state. The ATF plasma has a major radius of 2.1 m, an average minor radius of 0.3 m, and a field of 2 T for a 2 s duration or 1 T steady state. The ATF device consists of a helical field (HF) coil set, a set of poloidal field (PF) coils, an exterior shell structure to support the coils, and a thin, helically contoured vacuum vessel inside the coils. The ATF replaces the Impurities Studies Experiment (ISX-B) tokamak at ORNL and will use the ISX-B auxiliary systems including 4 MW of electron cyclotron heating. The ATF is scheduled to start operation in late 1986. An overview of the ATF device is presented, including details of the construction process envisioned. DOE

N86-27083# Stuttgart Univ. (West Germany). Inst. fuer Plasmaforschung.
[ACTIVITIES REPORT OF THE INSTITUTE OF PLASMA RESEARCH] Annual Report, 1984
1984 24 p
(ESA-86-96920) Avail: NTIS HC A02/MF A01

Research concerning electron cyclotron heating; plasma theory (stochastic effects, numerical plasma simulation); laser diagnostics; and plasma focus is summarized. ESA

N86-27084# Stuttgart Univ. (West Germany). Inst. fuer Plasmaforschung.
BIFURCATION, INTERMITTANCY AND CHAOS IN A DRIVEN THREE WAVE SYSTEM
E. Raeuchle Dec. 1984 30 p
(IPF-84-11; ESA-86-96921) Avail: NTIS HC A03/MF A01

A dissipative system consisting of three waves in which one wave is excited additionally from outside is considered. The amplitude of the external wave is modulated in time. This model can be considered as a general element of turbulence theory. It corresponds formally to a driven dissipative nonlinear oscillator, where subharmonics and chaos are observed, e.g., for the Duffing equation and the Helmholtz equation. For the system investigated, all these nonlinear phenomena appear similarly. The solutions of this system are characterized by bifurcations, intermittency and chaos. ESA

N86-27085# Stuttgart Univ. (West Germany). Inst. fuer Plasmaforschung.
ASSESSMENT OF THE POSSIBLE USE OF THE KE 1 THOMSON SCATTERING COLLECTION OPTICS FOR AN ADDITIONAL LIDAR SYSTEM
K. Hirsch and H. Salzmann 10 Feb. 1985 67 p
(IPF-85-1; ESA-86-96922) Avail: NTIS HC A04/MF A01

The possibility of using parts of the KE 1 Thomson scattering system simultaneously for a lidar type backscattering plasma diagnostic is discussed. In the KE 1 system the laser beam is passed vertically through the plasma. The scattered light is collected by a large Newtonian mirror optics. This optics consists of a closely spaced array of seven mirrors collecting the scattered light through a corresponding array of windows. The modification consists in using the central window of the array as laser input window. If the lidar laser beam is reflected into the torus by a large mirror located on the backside of the small Newtonian mirror of the KE 1 system, the central mirror of the KE 1 collection system is screened. The modification produces a solid angle of collection for the unvignettedly observed plasma center 10 times larger than the unmodified lidar design. Wall material ablation, and vignetting along the spatial chord are possible. ESA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N86-27086# Sandia National Labs., Albuquerque, N. Mex.
ELECTRONIC TRANSPORT IN BORON CARBIDES
D. Emin 1985 22 p refs Presented at Conf.
(Contract DE-AC04-76DP-00789)
(DE86-003721; SAND-85-1340C; CONF-850786-8) Avail: NTIS HC A02/MF A01

The electronic transport of boron carbides, B/sub 1-x/C/sub x/ with 0.1 less than or equal to x less than or equal to 0.2, between 300 K and 1200 K is inconsistent with conventional models of both itinerant and hopping transport. While the thermally activated conductivities and the low weakly activated Hall mobilities suggest the hopping of a high density (approx. 10(21) cm(-3)) of small polarons, the spin densities are orders of magnitude smaller than this. Furthermore, the p-type Seebeck coefficients are both large (>100 (MU)V/K) and strongly increasing functions of temperature, rather than being small and weakly temperature dependent as expected of degenerate semiconductors. Finally, unlike standard hopping systems, the electrical conductivity decreases with applied pressure. This is due to a pressure dependent increase of the conductivity activation energy. The anomalous thermoelectric, magnetic, and pressure-dependent transport properties are attributed to the charge carriers being hole-like small singlet bipolarons which hop between inequivalent B11C icosahedra. DOE

N86-27087# Virginia Univ., Charlottesville. Dept. of Physics.
SPECTROSCOPY OF SURFACE ADSORBED MOLECULES (SCANNING TUNNELING MICROSCOPY) Progress Report, 1 May 1985 - 30 Apr. 1986
R. V. Coleman 1986 64 p refs
(Contract DE-FG05-84ER-45072)
(DE86-004508; DOE/ER-45072/18) Avail: NTIS HC A04/MF A01

A review of the scanning tunneling microscopy program is given. This article contains a description of the design and

fabrication of the microscope in addition to description of studies which use the microscope: studies of charge-density waves and studies of tunnel junctions doped with metals and semiconductors. DOE

N86-27088# Sandia National Labs., Albuquerque, N. Mex.
PRESSURE-DEPENDENT MAGNETO-OPTIC MEASUREMENTS IN STRAINED-LAYER SUPERLATTICES AT LOW TEMPERATURES
E. D. Jones, J. E. Schirber, I. J. Fritz, P. L. Gourley, R. M. Biefeld, L. R. Dawson, and T. J. Drummond 1985 6 p Presented at the Materials Research Society Meeting
(Contract DE-AC04-76DP-00789)
(DE86-004604; SAND-85-1425C; CONF-851217-20) Avail: NTIS HC A02/MF A01

Magneto-optic studies on InGaAs/GaAs and GaAs/GaPAs strained-layer superlattices are used to determine the in-plane light-hole valence-band effective masses. Also, hydrostatic pressure-dependent magneto-optic studies have been performed on these samples for magnetic fields up to 65 kG and pressures to 4 kbar in the temperature range of 1.6 to 4 K. The experimental pressure coefficients of the band-gap energy and the effective mass in the InGaAs/GaAs SLS structures were determined. DOE

N86-27089# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
FOCUSED ION BEAM FABRICATION OF GRADED CHANNEL FET'S IN GaAs AND Si Semiannual Technical Report, 1 Jul. - 31 Dec. 1985
John Melngailis 27 Jan. 1986 7 p refs
(Contract MDA903-85-C-0215)
(AD-A163475) Avail: NTIS HC A02/MF A01 CSCL 20/12

The aim of this program is to fabricate field effect transistors in Si and GaAs in which the doping in the channel is varied as a function of distance from source to drain. The focused ion beam machine is a unique tool which is capable of producing such graded implants. In achieving this goal alignment procedures of the focused ion beam to existing features on the wafer have to developed, and the focused ion beam implants must be characterized and compared to conventional implants. In addition, models of the behavior of the graded channel devices must be developed. GRA

N86-27090# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
HILLOCK FORMATION ON (100) GaAs
S. I. Boldish and P. M. Adams 27 Nov. 1985 19 p
(Contract F04701-85-C-0086)
(AD-A163308; TR-0086(6925-01)-1; SD-TR-85-81) Avail: NTIS HC A02/MF A01 CSCL 20/12

For application to the growth of gallium arsenide (GaAs) by metal-organic chemical vapor deposition, the dependence of surface morphology and hillock formation on crystal orientation, AsH3/TMG ratio, and oxide contamination was investigated. Layers of GaAs were deposited on undoped liquid-encapsulated Czochralski (LEC) GaAs substrates oriented either (100) or (100)+ 2 deg yields <110>. Substrate orientation was checked by Laue X-ray diffraction. Surface features were observed by phase contrast optical microscopy and surface profilometry. To examine the relationship of hillock formation to oxide contamination, GaAs substrate surfaces were exposed to water vapor prior to epitaxial growth. GRA

N86-27091# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
EXPERIMENTAL DETERMINATION OF THE ELECTRONIC STRUCTURE OF SMALL METAL PARTICLES Interim Report
C. Caprile, A. Franciosi, D. Wielickza, and C. G. Olson 31 Dec. 1985 10 p
(Contract N00014-84-K-0545)
(AD-A163406; IR-6) Avail: NTIS HC A02/MF A01 CSCL 20/12

Low electronegativity metals such as Sm, Cs, and Na have been examined in the search for metal with strong catalytic activity in promoting the oxidation of semiconductor surfaces. A preliminary study shows that Sm overlayers appear to yield the maximum oxidation promotion observed to date on the Si(111) surface. The Sm chemisorption process, following a peculiar two-step sequence on Si(111) and GaAs (110) surfaces, is examined. At submonolayer metal coverage Sm atoms are in a mostly divalent state. At higher metal coverages trivalent Sm species dominate.At least in the case of Si the oxidation promotion effect appears related to the appearance of the trivalent state. This complex chemisorption process is still far from being completely understood. In this paper we present a simple experimental technique to study the electronic structure of metals in cluster or thin film form on ideally inert substrates. We apply this technique to Sm and we make systematic comparisons of the results for Sm chemisorption onto semiconductor surfaces and Sm adsorption onto inert substrates (solid Xe). In this first preliminary paper we give a very brief summary of the experimental technique and present selected results on cluster-size induced valence transition and on size-dependent metal screening during Sm adsorption on Xe. GRA

N86-27092# Harry Diamond Labs., Adelphi, Md.
CLASSICAL DERIVATION OF NONLINEAR SUSCEPTIBILITIES FOR THE 32 CRYSTAL CLASSES IN THE HARMONIC OSCILLATOR APPROXIMATION
Clyde A. Morrison and Mary S. Tobin Jan. 1986 85 p refs
(AD-A164536; HDL-TR-2078) Avail: NTIS HC A05/MF A01 CSCL 20/2

New applications relating to optical information processing, optical limiting, and frequency-agile laser systems have produced a resurgence of interest in nonlinear optical materials. In this work, we extend the classical anharmonic analysis to describe the nonlinear optical properties of the 32 crystal classes. We derive expressions for and relationships between the nonlinear susceptibility tensor elements in terms of the anharmonic force constants according to the crystal class symmetry. We show that all the susceptibilities thus derived (Chi (1), Chi (2), and Chi (3)) obey the Kleinman conditions. Finally, we discuss the possible application of these results, coupled with a point-charge model, for estimating the nonlinear force constants, in the prediction of potential new nonlinear materials. GRA

N86-27093# Minnesota Univ., Minneapolis.
MICROSCOPIC CONTROL OF SEMICONDUCTOR INTERFACE REACTIVITY Annual Report, 1 Aug. 1984 - 31 Jul. 1985
A. Franciosi 10 Jan. 1986 67 p refs
(Contract N00014-84-K-0545)
(AD-A164560; AR-7) Avail: NTIS HC A04/MF A01 CSCL 07/4

In recent years a number of metal overlayers on silicon have been shown to yield an increase in silicon oxidation rate when the surface is exposed to an oxidizing atmosphere. Metals as diverse as Au, AG, Cu, Pd all give rise to promotion effects, with the production of Si-oxide phases of variable stoichiometry. In the case of Au and Cr, the Si-oxide appears to nucleate on top of the metal overlayer. To the extent that the metal atoms increase the surface reaction kinetics and do not appear directly involved in the reaction product, i.e., the surface silicon oxide, they play the role of a catalyst. Since the magnitude of the effect depends on the overlayer-silicon interface morphology, in the absence of a more precise denomination we refer to such phenomena as interface catalytic effects. The main goal of our program is to investigate the microscopic mechanisms which determine these effects, characterize the electronic and structural modifications that accompany the surface reactions, determine the stoichiometry of the reaction products and/or the interface composition profile, and ultimately obtain and enhanced control of the kinetics of surface reactions with gaseous species and metals. Long term practical aplications include the synthesis of new insulating and metallic epitaxial layers on Si and GaAs and enhanced control of interdiffusion and contact stability. GRA

N86-27094# Harvard Univ., Cambridge, Mass. Div. of Applied Sciences.
STABILITY AND PROPERTIES OF COMPOSITIONALLY MODU-

LATED FILMS Interim Report
R. C. Cammarata, S. M. Prokes, and F. Spaepen Nov. 1985 31 p refs
(Contract N00014-85-K-0023)
(AD-A164574; TR-28) Avail: NTIS HC A03/MF A01 CSCL 20/12

The thermodynamics and kinetics governing the stability of compositionally modulated materials are reviewed. Typical results of experiments on fcc and amorphous metals are presented to demonstrate the effects of interdiffusion. Two coarsening mechanisms are analyzed, as is the stability of orthogonal waves in phase separating systems. The interdiffusivity between amorphous Si and Ge in the temperature range 550 to 630 K is 1.07x10 to the minus 10th power exp(-1.6 ev/kT)m2 1/s, for a modulation wavelength of 5.83 nm. No crystallization occurred during the anneals. The theories for the enhancement of the elastic modulus in crystalline compositionally modulated films are reviewed. Both the Fermi sphere-Brillouin zone interaction model and the coherency stress model are found to be inadequate and insufficiently developed. Author (GRA)

N86-27095# Rutgers - The State Univ., Piscataway, N. J. Dept. of Mechanics and Materials Science.
FIELD INDUCED DIPOLE REORIENTATION AND PIEZOELECTRICITY IN HEAVILY PLASTICIZED NYLON 11 FILMS
J. I. Scheinbeim, S. C. Mathur, and B. A. Newman 6 Jan. 1986 27 p refs
(Contract N00014-80-C-0795)
(AD-A164683; TR-6) Avail: NTIS HC A03/MF A01 CSCL 09/3

Nylon 11 films with very low initial crystallinity were made by dissolving the nylon 11 in 2-Ethyl 1,3 Hexanedoil at 150 C. Films were cast from the solution and excessive plasticizer was removed in a vacuum oven. Films were then melt-pressed and quenched to yield heavily plasticized nylon 11 films containing 30% by weight of the plasticizer. These films were poled under vacuum to allow the plasticizer to evaporate in the presence of an electric field. A high piezoelectric response was observed for the films subjected to the maximum electric field while the sample contained a large fraction of plasticizer. Significant development of crystallinity was observed without apparent indication of orientation of the crystallites. These studies suggest that the observed piezoelectric response originates primarily from oriented hydrogen bonds in the amorphous regions of nylon 11. GRA

N86-27096# Columbia Univ., New York. School of Mines.
ELECTRICAL MEASUREMENTS ON ALPHA-QUARTZ CRYSTALS Final Technical Report, Nov. 1981 - Dec. 1984
A. S. Nowick Dec. 1985 53 p
(Contract F19628-82-K-0013)
(AD-A164793; RADC-TR-85-174) Avail: NTIS HC A04/MF A01 CSCL 20/2

This study was aimed at achieving a better understanding of the defects in alpha-quartz crystals that affect their frequency stability. The principal techniques used were electrical conductivity and dielectric loss measurements, both of which are largely controlled by alkalis present to compensate for substitutional Al(3+). In order to deal with just one alkali species at a time, samples studied were swept with either Li+ or Na+. The results involve considerable information about Al-Na and Al-Li bound pairs in the crystal, about alkalis freed from these pairs that give rise to the conductivity, and about the defects (which include electrons and holes) produced by X-ray irradiation of these crystals. The Al-Na pairs can exist in two configurations (alpha and beta) with the Sodium on opposite sides of the AlO4 tetrahedron, off the C2 symmetry axis. In Aluminum-Lithium, however, the Li(+) sits on the C2 axis. The alkalis freed at high temperature give rise to the conductivity and involve a higher activation energy for Li+ and for Na+. Finally, upon irradiation, liberated alkalis form new centers which produce a striking low-temperature dielectric loss peak. The use of computer simulation calculations has also been shown to be a helpful adjunct to the electrical measurements. GRA

N86-27097# Rome Air Development Center, Griffiss AFB, N.Y.
THE EFFECTS OF ARSINE PRESSURE ON THE COMPOSITIONS, CARRIER CONCENTRATIONS, MOBILITIES AND GROWTH RATES OF EPITAXIAL LAYERS OF Ga(x)In(1-x)As PREPARED BY THE VPE (VAPOR-PHASE EPITAXY)-HYDRIDE TECHNIQUE
David W. Weyburne and Kenneth P. Quinlan Nov. 1985 20 p
(AD-A165278; RADC-TR-85-238) Avail: NTIS HC A02/MF A01 CSCL 20/12

The effect of three arsine partial pressure on the preparation of the ternary, Ga(x)In(1-x)As, was investigated. Operational parameters are given for the preparation of Ga(0.47)In(0.53)As at these pressures. Increased arsine partial pressures decreased the gallium composition of the ternary. Growth rates have been determined as a function of gallium monochloride and arsine partial pressures. Increased mole fractions of arsine do not lower carrier concentrations or increase mobilities of the Ga(x)In(1-x)As layers. GRA

N86-27098# Scientific Research Associates, Inc., Glastonbury, Conn.
TRANSIENT TRANSPORT IN BINARY AND TERNARY SEMICONDUCTORS Final Report, 27 Sep. 1982 - 26 Sep. 1985
H. L. Grubin, J. P. Kreskovsky, M. Meyyappan, and B. J. Morrison 27 Feb. 1986 62 p
(Contract DAAG29-82-C-0023)
(AD-A165464; SRA-R930009-F; ARO-18480.5-EL) Avail: NTIS HC A04/MF A01 CSCL 20/12

A description of recent studies of two and three terminal band structure dependent compound semiconductors is given. GRA

N86-27099# California Univ., Los Angeles. Dept. of Chemistry and Biochemistry.
SOLID-PHASE EQUILIBRIA IN THE Au-Ga-Sb, Au-In-As, AND Au-In-Sb TERNARIES
C. T. Tsai and R. S. Williams 28 Feb. 1986 36 p Prepared for publication
(Contract N00014-83-K-0612)
(AD-A165469; TR-12) Avail: NTIS HC A03/MF A01 CSCL 20/12

The Au-Ga-As, Au-Ga-Sb, Au-In-As, and Au-In-Sb ternaries were surveyed using X-ray powder diffraction to determine which metallic phases exist at equilibrium with the III-V compound semiconductors. In closed, small-volume systems (i.e., formation of gas-phase products was prevented), Au does not react with GaAs but does react with the other III-V's investigated to produce Au-Group III intermetallic compounds and another solid phase containing the group V element. However, each semiconductor formed pseudobinary systems with at least two different intermetallic compounds. The bulk phase diagrams determined in this study provide frameworks within which much of the experimental data in the literature concerning the products of reactions at Au/III-V interfaces can be understood. GRA

N86-27100# California Univ., Los Angeles. Dept. of Chemistry and Biochemistry.
ENTROPY-DRIVEN LOSS OF GAS-PHASE GROUP 5 SPECIES FROM GOLD/3-5 COMPOUND SEMICONDUCTOR SYSTEMS
John H. Pugh and R. Stanley Williams Feb. 1986 36 p
(Contract N00014-83-K-0612)
(AD-A165584; TR-11) Avail: NTIS HC A03/MF A01 CSCL 07/2

Temperature dependent chemical interactions between Au and nine 3-5 compound semiconductors (3=A1, Ga, In and V=P, As, Sb) have been calculated using bulk thermodynamic properties. Enthalpic considerations alone are insufficient to predict metal/compound-semiconductor reactivities. The entropy of vaporization of the group 5 elements is shown to be an extremely important driving force for chemical reactions involving the 3-5's, since it enables several endothermic reactions to occur spontaneously under certain temperature and pressure conditions. Plots of either Gibb's free energies of reaction or equilibrium vapor pressure of the group 5 element versus temperature are used to

predict critical reaction temperatures for each of the systems studied. These plots agree extremely well with previous experimental observations of thin film reactions of Au on GaAs. GRA

N86-27101# North Carolina State Univ., Raleigh. Dept. of Materials Engineering.
AMORPHIZATION AND RECRYSTALLIZATION PROCESSES IN MONOCRYSTALLINE BETA SILICON CARBIDE THIN FILMS
J. A. Edmond, S. P. Withrow, H. S. Kong, and R. F. Davis 1985 14 p Presented at the Materials Research Society Meeting Prepared in cooperation with Oak Ridge National Lab., Tenn.
(Contract DE-AC05-84OR-21400)
(DE86-004797; CONF-851217-15) Avail: NTIS HC A02/MF A01

Individual, as well as multiple doses of (27)Al(+), (31)P(+), (28)Si(+), and (28)Si(+) and (12)C(+), were implanted into (100) oriented monocrystalline (BETA)-SiC films. The critical energy of approx. =16 eV/atom required for the amorphization of (BETA)-SiC via implantation of (27)Al(+) and (31)P(+) was determined using the TRIM84 computer program for calculation of the damage-energy profiles coupled with the results of RBS/ion channeling analyses. In order to recrystallize amorphized layers created by the individual implantation of all four ion species, thermal annealing at 1600, 1700, or 1800 C was employed. Characterization of the recrystallized layers was performed using XTEM. Examples of SPE regrown layers containing precipitates and dislocation loops, highly faulted-microtwinned regions, and random crystallites were observed. DOE

N86-27102# Sandia National Labs., Albuquerque, N. Mex.
OPTICAL IMAGING OF DISLOCATIONS IN STRAINED-LAYER SUPERLATTICES AND LATTICE-MISMATCHED EPILAYERS
P. L. Gourley, R. M. Biefeld, and L. R. Dawson 1985 6 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985
(Contract DE-AC04-76DP-00789)
(DE86-004620; SAND-85-2664C; CONF-851217-16) Avail: NTIS HC A02/MF A01

We have developed a convenient photoluminescence micro-imaging technique to probe misfit dislocations in epitaxially grown semiconductor alloys and multilayers. Using this technique, we have examined the microscopic optical quality of thick (approx.1 (MU)m) III-V semiconductor epitaxial layers, mismatched to their substrates. The layers include several kinds of [100] strained-layer superlattices (GaP/GaAs/sub x/P/sub 1-x/ on GaP and GaAs/GaAs/sub 1-x/P on GaAs grown by MOCVD, AND GaAs/In/sub x/Ga/sub 1-x/As on GaAs grown by MBE) and associated alloys. For each type of superlattice, we have studied a large number of samples corresponding to different compositions and layer thicknesses. The results show that misfit dislocations can be completely eliminated in the uppermost layers of the strained-layer superlattices if these structures have thin layers, less than the critical thickness for elastic accommodation, and sufficient numbers of interfaces to block threading dislocations. DOE

N86-27103# Supercon, Inc., Shrewsbury, Mass.
DEVELOPMENT OF HIGH FIELD SUPERCONDUCTORS FOR FUSION ENERGY APPLICATIONS Progress Report, 1 Aug. 1984 - 15 Jan. 1985
1985 5 p
(Contract DE-AC01-80ER-52068)
(DE86-004834; DOE/ER-52068/T10) Avail: NTIS HC A02/MF A01

Fabrication and testing of superconducting materials is discussed. Fabrication of the X-type internal bronze material to 0.016 in. (0.406 mm) diameter yields 720 A/mm(2) in the non-copper at 10 T and 4.2 K and a sensitivity of 1.5 (MJ)V/cm). Plans for the preparation of the MIT test coil are reported. DOE

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N86-27104# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF THE REACTION SURFACE WITH FREEZING LEWIS NUMBER NOT EQUAL TO 1 AND ITS APPLICATION IN THE OXIDATION-SUBLIMATION COUPLING PROCESS
Jiakang Zhong 13 Dec. 1985 17 p Transl. into ENGLISH from Lixue Xuebao (China), v. 16, no. 1, Jan. 1984 p 27-35
(AD-A163213; FTD-ID(RS)T-0633-85) Avail: NTIS HC A02/MF A01 CSCL 20/13

A theoretical analysis of the reaction surface of a locally similar laminar boundary layer with addition of mass and chemical reaction is presented. Heat transfer and mass transfer correlations under the condition freezing Lewis Number not equal to 1 are derived. As an application of the theory of the reaction surface, the oxidation sublimation coupling process on the surface material is investigated. The transition mechanism and transformation condition of the oxidation and sublimation processes from rate-controlled to diffusion-controlled regimes are described. The phenomenon that the rate-sublimation is involved in diffusion-controlled oxidation regime is shown. Comparisons with the experimental data are made for the case of graphite stagnation ablation, and quantitative agreement is found. GRA

N86-27105# Texas Univ. at Dallas, Richardson. Center for Quantum Electronics.
THE DEMONSTRATION OF THE FEASIBILITY OF THE TUNING AND STIMULATION OF NUCLEAR RADIATION Annual Summary Report, 1 Jan. - 31 Dec. 1985
Carl B. Collins 31 Jan. 1986 43 p
(Contract N00014-81-K-0653)
(AD-A164530) Avail: NTIS HC A03/MF A01 CSCL 20/8

This project concerns the demonstration of the feasibility of the tuning and perhaps even stimulation of nuclear radiation. Theory has indicated that anti-Stokes Raman upconversion of intense but conventional long wavelength sources of radiation produced by scattering from isomeric states of nuclear excitation could lead to significant sources of tunable gamma-radiation characterized by the natural Mossbauer widths of the lines. This would result in lines with sub-Angstrom wavelengths and widths of a few MHz. Whether or not these processes can reach threshold depends upon the resolution of basic issues lying in an interdisciplinary region between quantum electronics and nuclear physics that have not been previously addressed. It was the purpose of this work to study these issues experimentally. GRA

N86-27106# Boston Univ., Mass. Dept. of Physics.
FIELD THEORETIC INVESTIGATIONS ON PARTICLE PHYSICS AND COSMOLOGY Annual Technical Progress Report
S. Y. Pi 1985 13 p
(Contract DE-AC02-83ER-40118)
(DE86-004516; DOE/ER-40118/1) Avail: NTIS HC A02/MF A01

Topics covered include bridging particle physics and cosmology, superconducting universe, inflationary universe, density fluctuations in the new inflationary universe, a realistic inflationary model, and the quantum mechanics of the scalar field in the new inflationary universe. DOE

N86-27107# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands). Sectie-H.
ON THE QUANTIZATION OF NONCONTACT FIELD THEORIES IN MINKOWSKI SPACE
J. W. vanHolten Oct. 1985 14 p Revised report of RUU-CS-85-3
(NIKHEF-H/85-12; B8578199; ESA-86-97016) Avail: NTIS

HC A02/MF A01

The definition and regularizaton of Minkowski-space path integrals for field theories with noncompact field manifolds is examined. It is shown that a quantization procedure including constrained auxiliary field components in a positive definite Hilbert space necessarily requires nonstandard analytic continuation of Green's functions for these constrained fields. ESA

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N86-27108* National Aeronautics and Space Administration, Washington, D.C.
MANAGEMENT: A BIBLIOGRAPHY FOR NASA MANAGERS
Apr. 1986 169 p
(NASA-SP-7500(20); NAS 1.21:7500(20)) Avail: NTIS HC A08 CSCL 05A

This bibliography lists 707 reports, articles and other documents introduced into the NASA scientific and technology information system in 1985. Items are selected and grouped according to their usefulness to the manager as manager. Citations are grouped into ten subject categories: human factors and personnel issues; management theory and techniques; industrial management and manufacturing; robotics and expert systems; computers and information management; research and development; economics, costs, and markets; logistics and operations management; reliability and quality control; and legality, legislation, and policy. Author

N86-27109# Los Alamos National Lab., N. Mex.
CREATIVITY IN SCIENCE - A SYMPOSIUM
M. R. Raju, ed., J. A. Phillips, ed., and F. Harlow, ed. Aug. 1985 143 p Presented at the Creativity in Science Symposium, Los Alamos, N. Mex., 13-14 Aug. 1984
(Contract W-7405-eng-36)
(DE86-003289; LA-10490-C; CONF-8408177) Avail: NTIS HC A07/MF A01

This conference proceeding is a collection of the talks and panel discussions for the symposium, Creativity in Science, held at Los Alamos National Laboratory August 13 and 14, 1984. Also included is a related colloquium and dialogue by J. Krishnamurti, which took place at Los Alamos National Laboratory on March 20 and 21, 1984. The symposium addressed issues concerning individual creativity and management for creativity. DOE

N86-27110# George Mason Univ., Fairfax, Va. Technology Transfer Study Center.
TECHNOLOGY TRANSFER AT DARPA: THE DEFENSE ADVANCED RESEARCH PROJECTS AGENCY. EXECUTIVE SUMMARY
Ronald G. Havelock and David S. Bushnell Dec. 1985 15 p refs
(Contract MDA903-84-K-0031; ARPA Order 5156)
(AD-A164503) Avail: NTIS HC A02/MF A01 CSCL 05/1

Five distinct transfer issues were uncovered, namely: (1) transfer within programs (intra-transfer); (2) transfer to military users (hand-off); (3) transfer to non-military users (spin-off); (4) undesired transfer or leakage (defined as the problem of knowledge containment); and (5) transfer into DARPA from other sources (in-transfer). Five specific recommendations are offered for early action to begin a more coherent and aggressive approach to transfer issues within the Agency. First, the Agency should immediately appoint a technology transfer facilitator to oversee the transition of developed technology to military use. Second, it should develop a state-of-the-art on-line retrieval system for tracking data on all projects and proposals. Third, it should develop a new system of program tracking to identify critical stages and outcomes, which we call transition analysis. Fourth, it should convene a panel on access to unclassified technical knowledge. Finally, it should establish an annual forum for the review of newly emerging technologies. A brief summary of each recommendation is given. GRA

N86-27111# Navy Personnel Research and Development Center, San Diego, Calif.
INDEPENDENT RESEARCH AND INDEPENDENT EXPLORATORY DEVELOPMENT FY 85 Annual Report, Oct. 1984 - Sep. 1985
Robert Penn and Alice Crawford Jan. 1986 63 p
(AD-A163432; NPRDC-SR-86-1) Avail: NTIS HC A04/MF A01 CSCL 05/1

This report provides summaries of FY85 Independent Research (IR) and Independent Exploratory Development (IED) efforts and the IR/IED funding profile, as well as IR/IED researchers' awards and honors for FY85 and presentations and publications based on IR/IED efforts. The following IR efforts are described: Models for calibrating multiple-choice items: Enhancing understanding of electric circuits: Cognitive and effective processing; Cognitive factors in learning and retention; Reward system design and performance; Relationships between management practices and organizational performance; Analysis of cognition in natural settings; and Expert systems for fault diagnosis. The following IED efforts are described: Multiple criterion optimization techniques; Interfaces for combat decision support; and Development of graphic design aids. GRA

N86-27112# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
CALENDAR OF SELECTED AERONAUTICAL AND SPACE MEETINGS DECEMBER 1985
Dec. 1985 146 p In ENGLISH and FRENCH
(AD-A164535; AGARD-CAL-85/2) Avail: NTIS HC A07/MF A01 CSCL 05/2

The purpose of this publication is to assist members of the Aeronautical and Space Community by: (1) informing them about many International Scientific and Technical Meetings scheduled; (2) avoiding the need for them to consult several sources in order to find out what meetings have been planned, their dates and locations. GRA

N86-27113# Colorado Univ., Boulder. Center for Research on Judgement and Policy.
A THEORETICALLY BASED REVIEW OF THEORY AND RESEARCH IN JUDGMENT AND DECISION MAKING
Kenneth R. Hammond Feb. 1986 96 p refs
(Contract N00014-81-C-0591)
(AD-A164914; CRJP-260) Avail: NTIS HC A05/MF A01 CSCL 05/10

Barriers to unification lie in the false dichotomy and rivalry between intuition and analysis, the arbitrary choice of task conditions, and the absence of a theory of successful intuition, as well as in current research practices. A theoretical framework is presented that is intended to overcome these barriers. The theory is anchored in task conditions, specifies the variety of cognitive properties they induce, and indicates subsequent behavior. GRA

N86-27114# Naval Postgraduate School, Monterey, Calif.
THE USE OF FORM, FIT, AND FUNCTION IN THE ACQUISITION OF MAJOR WEAPON SYSTEMS M.S. Thesis
Douglas M. Deets Dec. 1985 102 p refs
(AD-A165000) Avail: NTIS HC A06/MF A01 CSCL 15/5

This thesis was undertaken to analyze the use of Form, Fit, and Function as a second sourcing methodology for major weapon systems. The major objectives of the research were to

determine what the attributes of Form, Fit, and Function were and how it could best be successfully employed. The researcher found that the Form, Fit, and Function would most likely not be used for the reprocurement of entire weapon systems. The real potential of this methodology was in the procurement of components and subsystems. In this regard, it can be used successfully for simple or technically complex items, initial or follow-on buys, and as means of retrofitting existing equipments. Since there is no need to transfer technical data between sources as in the other second sourcing methodologies, Form, Fit, and Function can also be used when the transfer of technology is impossible, impractical or inappropriate. GRA

N86-27115# Naval Postgraduate School, Monterey, Calif.
AN APPLICATION OF COST RISK IN INCENTIVE CONTRACTS M.S. Thesis
Christopher M. McGrath Dec. 1985 96 p
(AD-A165177) Avail: NTIS HC A05/MF A01 CSCL 14/1

This thesis begins with an examination of the literature concerning incentive contract effectiveness and contractor motivation. Citing the most frequently supported conclusions, the researcher integrates these with a cost risk analysis methodology based upon the Beta distribution. The result is a share curve that automatically adjusts the share ratio based upon estimated cost variance. The researcher suggests that this approach is better at reflecting cost risk than the standard linear design. The share curve provides more risk sharing, especially at higher levels of cost variance, and provides both significant rewards and penalties only for significant deviations from target cost. The final conclusion is that the share curve mitigates the defense contractors' risk averse nature, thus allowing the profit motive to become operative in incentivizing the contractor to control or reduce costs. GRA

N86-27116# Bundesministerium fuer Wissenschaft und Forschung, Vienna (Austria).
REPORT OF THE WEST GERMANY FEDERAL GOVERNMENT ON RESEARCH Annual Report, 1984
1984 61 p
(ESA-86-96940) Avail: NTIS HC A04/MF A01

The West German research and technology policy is described. The freedom of science; technical progress and trends; and the promotion of research are discussed. ESA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software.*

N86-27117# Oak Ridge National Lab., Tenn.
QUALITY CONTROL IN RESEARCH DATA BASES: THE US ENVIRONMENTAL PROTECTION AGENCY NATIONAL SURFACE WATER SURVEY EXPERIENCE
P. Kanciruk, R. J. Olson, and R. A. McCord 1985 29 p Presented at the Research Data Management in the Ecological Sciences Symposium, Georgetown, S.C.
(Contract DE-AC05-84OR-21400)
(DE86-002249; CONF-8511112-1) Avail: NTIS HC A03/MF A01

The usefulness of a research data base is in part determined by the quality of the information it contains. The procedures involved in ensuring the production of a high quality data base are collectively termed quality assurance. To ensure that data are as accurate as possible, the research data base manager ideally should have the research and data management background to be involved from the point of project design, data verification and validation, through the documentation and dissemination of the final data. This ideal is not often realized. One exception, however, is Phase 1 of the US Environmental Protection Agency's National Surface Water Survey. Beginning in the fall of 1984, this 3-month field survey will sample 2100 lakes in the northeast, southeast, and upper midwest regions of the United States. Another 900 western lakes will be sampled in the fall of 1985. The survey uses helicopters to take water samples that are chemically analyzed at remote laboratories. The survey will synoptically define the extent of existing surface water acidification and the number of lakes potentially at risk because of acidic deposition. DOE

N86-27118# Defense Technical Information Center, Alexandria, Va.
PROCEEDINGS OF THE 1985 ANNUAL DTIC USERS CONFERENCE
Judith A. Pickeral, Compiler 1985 230 p Proceedings held in Alexandria, Va., 23-25 Oct., 1985
(AD-A166250; DTIC/TR-86/7) Avail: NTIS HC A11/MF A01 CSCL 05/2

The proceedings of the 1985 Annual DTIC Users Conference consist of transcriptions of presentations. The presentations include: status report, wrap-up, and question-and-answer sessions provided by DTIC's Directors and Program Managers; reports from the Defense RDT&E Online System (DROLS) User Council; R&D Planning Information Management initiatives; a review of DROLS Communications; a New User Orientation introducing relatively new users to DTIC's product and services; DROLS Workshops for Dedicated and Dial-up Terminals providing discussions on new system features, training tips, search problems, and questions; panel discussions on procedures and problems associated with the release of Limited Documents; an overview of four DTIC Intern Papers; sessions on How To Promote DTIC's Products and Services to Your User Community; an update on Corporate Planning at DTIC; policy and procedural aspects of Export Control; and the results of a study on Army Use of DTIC. Author

N86-27119# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Geotechnical Lab.
PIEZOMETER DATA BASE PACKAGE USER'S GUIDE Final Report
Earl V. Edris, Jr. and Wipawi Vanadit-Ellis Oct. 1985 163 p
(AD-A163264; WES/IR/GL-85-2) Avail: NTIS HC A08/MF A01 CSCL 05/2

A data base package for storage, retrieval, and display of piezometer data for geotechnical projects is described. Detailed instructions are given for using the package for monitoring piezometers, rapid retrieval of data, and display of piezometer locations, time history plots, and piezometer readings with embankment profiles. The package provides for easy, interactive data entry and editing with automatic data checks and error messages when data exceed user specified ranges. Data storage and retrieval are accomplished using the CE-owned SYSTEM 2000 Data Base Management System on the Corps-wide time-sharing service operated (1984) by Control Data Corporation. The data entry and retrieval programs developed for the package are designed for a low skill level and minimum training of personnel. Data entry can also be accomplished on CE District Harris computers. Author (GRA)

N86-27120# Naval Ocean Research and Development Activity, Bay St. Louis, Miss.
THE GEONAMES PROCESSING SYSTEM SYNOPSIS Final Report
Gail Langran Sep. 1985 34 p
(AD-A163366; NORDA-125) Avail: NTIS HC A03/MF A01 CSCL 14/3

The Defense Mapping Agency has recognized a need for digital procedures to store, retrieve, and edit geographic names data and to prepare names for product generation. DMA's stated goal is a 50 to 100 million name digital data base with subsystems to capture names, edit and format names data, and prepare names overlays for maps. NORDA began a geonames processing system design study late in FY82. This report summarizes NORDA's study findings. The four sections in Part One discuss geonames processing functions in turn: names data capture, data base management, editing and formatting, and map names processing.

Each subsystem is described, unresolved issues are highlighted, and recommendations are made. Part Two discusses concerns common to all four geonames processing subsystems. Section 5 defines interfaces between the subsystems. Section 6 weighs the technical possibilities for handling non-Roman alphabets and ideographs. Personnel and space requirements for a comprehensive names processing system are estimated in Section 7. Automated Alphanumeric Data Entry System (AADES); Geographic Names Data Base (GNDB); Advanced Symbol Processing (ASP); and Advanced Type Placement (ATP). GRA

N86-27121# Naval Postgraduate School, Monterey, Calif.
THE DESIGN AND ANALYSIS OF A NETWORK INTERFACE FOR THE MULTI-LINGUAL DATABASE SYSTEM M.S. Thesis
Clemon R. Wortherly Dec. 1985 127 p
(AD-A164756) Avail: NTIS HC A07/MF A01 CSCL 09/2

Traditionally, the design and implementation of a conventional database system begins with the choice of a data model followed by the specifications of a model-based data language. Thus, the database system is restricted to a single data model and a specific data language. An alternative to this traditional approach to database-system development is the multi-lingual database system (MLDS). This alternative approach affords the user the ability to access and manage a large collection of databases, via several data models and their corresponding data languages, without the aforementioned restriction. In this thesis, we present a methodology for supporting network (CODASYL) database management on the MLDS. Specifically, we design an interface which translates CODASYL-DML statements into ABDL requests. We describe the data structures, the control mechanisms, and the functions/procedures necessary to implement such a system. GRA

N86-27122# Naval Postgraduate School, Monterey, Calif.
RECENT NAVAL POSTGRADUATE SCHOOL PUBLICATIONS Summary Report, 1 Oct. 1983 - 30 Sep. 1984
Gilbert T. Howard 30 Sep. 1985 288 p
(AD-A164846; NPS-012-85-002PR) Avail: NTIS HC A13/MF A01 CSCL 05/2

This publication contains a listing for each faculty member from each department identifying conference presentations, contributions to books, published papers, and technical reports for the years 1981 to 1984. GRA

N86-27123# Naval Postgraduate School, Monterey, Calif.
THE IMPLEMENTATION OF A ENTITY-RELATIONSHIP INTERFACE FOR THE MULTI-LINGUAL DATABASE SYSTEM M.S. Thesis
Jacob A. Anthony, III and Alfred J. Billings Dec. 1985 156 p
(AD-A164858) Avail: NTIS HC A08/MF A01 CSCL 09/2

Traditionally, the design and implementation of a conventional database system begins with the choice of a data model followed by the specifications of a model-based data language. Thus, the database system is restricted to a single data model and a specific data language. An alternative to this traditional approach to database-system development is the multi-lingual database system (MLDS). This alternative approach enables the user to access and manage a large collection of databases via several data models and their corresponding data languages without the aforementioned restriction. This thesis presents the implementation of a entity-relationship/Daplex language interface for the MLDS. Specifically, it presents the implementation of an interface which translates Daplex language calls in to attribute-based data language requests. The authors describe the software engineering aspects of the implementation of an overview of the five modules which comprise the entity-relationship/Daplex language interface. Author (GRA)

N86-27124# Naval Postgraduate School, Monterey, Calif.
THE FORMAL SPECIFICATION OF AN ABSTRACT DATABASE: DESIGN AND IMPLEMENTATION M.S. Thesis
Klaus-Harald Zang Dec. 1985 364 p
(AD-A164865) Avail: NTIS HC A16/MF A01 CSCL 09/2

The technique of problem solving abstraction provides an appropriate tool for specifying an interface between the layers of computer hardware and software. Based on this methodology, the types of support and function calls that should be provided to application programs running on micro computers are described with respect to a database resource. The database is integrated with an abstract processor called AM, a machine which focuses on eliminating the problems with portability and reusability of software, imposed by insufficient resource abstraction. Author (GRA)

N86-27125# Naval Environmental Prediction Research Facility, Monterey, Calif.
DIRECTORY OF RESEARCH PUBLICATIONS
Jan. 1986 29 p
(AD-A164875) Avail: NTIS HC A03/MF A01 CSCL 05/2

This directory lists research publications produced by the Naval Environmental Prediction Research Facility (NEPRF) since the command was established in 1971. Abstracts of the last calendar year's publications also are provided. The following identification information is given: Report number assigned by NEPRF; Government accession (AD) number where assigned; Date of publication; The publication's title, author(s), and number of pages. Topics include such items as weather, tidal currents, data bases, and oceanic regions. GRA

N86-27126# Naval Postgraduate School, Monterey, Calif.
COMPILATION OF ABSTRACTS OF THESES SUBMITTED BY CANDIDATES FOR DEGREES Report, 1 Oct. 1983 - 30 Sep. 1984
30 Sep. 1985 558 p refs
(AD-A164988; NPS-012-85-003PR) Avail: NTIS HC A24/MF A01 CSCL 05/2

This publication contains the abstracts of theses submitted during the period 1 October 1983 to 30 September 1984 by candidates for Doctoral, Master's and Engineer's degrees at the Naval Postgraduate School, Monterey. Subject areas include: Aeronautical engineering, Electrical engineering, Mechanical engineering, Applied science, Computer science, Engineering acoustics, Hydrography, Information systems, Management, Meteorology and oceanography, Operations research, Systems technology (Antisubmarine warfare), Telecommunications systems management, and National security affairs. GRA

N86-27127# Naval Postgraduate School, Monterey, Calif.
THE IMPLEMENTATION OF A NETWORK CODASYL-DML INTERFACE FOR THE MULTI-LINGUAL DATABASE SYSTEM M.S. Thesis
Bulent Emdi 19 Dec. 1985 127 p refs
(AD-A164996) Avail: NTIS HC A07/MF A01 CSCL 09/2

Traditionally, the design and implementation of a conventional database system begins with the selection of a data model, followed by the specification of a model-based data language. An alternative to this traditional approach to database system development is the multi-lingual database system (MLDS). This alternative approach affords the user the ability to access and manage a large collection of databases via several data models and their corresponding data languages. This thesis presents the specification and implementation of an interface which translates CODASYL-DML data language calls into attribute-based data language (ABDL) requests. It describes the software engineering aspects of the implementation and an overview of the four modules which comprise our CODASYL-DML language interface. Author (GRA)

N86-27128# Naval Postgraduate School, Monterey, Calif.
RELATIONAL MODEL OF A DATA DICTIONARY M.S. Thesis
M. G. Dedeoglu Dec. 1985 85 p refs
(AD-A164998) Avail: NTIS HC A05/MF A01 CSCL 09/2

The data dictionary system is an important tool for supporting information resource management. It facilitates the management and control of data. This thesis will develop a relational model of a data dictionary and implement it on the ORACLE relational data base management system. Then, this data dictionary model will be implemented using the logic-oriented Prolog language. The Prolog model of a data dictionary will demonstrate that logic

programming can be used for relational data base applications and that it provides more powerful dictionary capabilities than the relational model. GRA

N86-27129# Decision Science Consortium, Inc., Falls Church, Va.
A PERSONALIZED AND PRESCRIPTIVE DECISION AID FOR CHOICE FROM A DATABASE OF OPTIONS Interim Technical Report, Jul. 1983 - Feb. 1986
Marvin S. Cohen, Kathryn B. Laskey, and Martin A. Tolcott 4 Mar. 1986 57 p
(Contract N00014-83-C-0485; f66-701)
(AD-A165396; TR-86-1) Avail: NTIS HC A04/MF A01 CSCL 05/10

In many decision-making contexts there is a need for aids which cater flexibly to individual users in their preferred ways of organizing information and solving problems, but which guard against potential errors or biases inherent in common approaches to decision making. DSC has developed principles of personalized and prescriptive decision aiding which respond to this need, and which are based on experimental findings and theoretical models in cognitive psychology. In Phase I of this project, those principles were applied to the development of an aid for attack submarine approach and attack. In Phase 2, the principles have been generalized and extended to the development of a generic personalized and prescriptive evaluation system. The system incorporates five basic cognitive interface modules to customize the user's interaction with the aid and to provide prescriptive guidance, as well as a set of interactive dialogues or guides which blend all five functions in support of specific user-selected decision-making strategies. The aid will be tested and demonstrated in the context of a personnel selection application. Author (GRA)

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

N86-27130# Congressional Research Service, Washington, D.C. Office of Senior Specialists.
PUBLIC LAWS OF THE 98TH CONGRESS RELATING TO INFORMATION POLICY
Sandra N. Milevski 14 Mar. 1986 101 p
(CRS-TK-7885-F) Avail: NTIS HC A06/MF A01

Statutes of the 98th Congress treating information related concerns are enumerated. Limited to public laws of a substantive nature, the topical overview of areas of congressional concern is divided into nine sections: Federal Information Resources Management; International Communications and Information Policy; Telecommunication, Broadcasting, and Satellite Transmission; Intellectual Property; Library and Archives Policies; Information Disclosure, Confidentiality and the Right of Privacy; Computer Security and Crime; Information Technology for Education, Innovation, and Competitiveness; and Government Information Systems, Clearinghouses, and Dissemination. Brief considerations of parallel developments in the executive branch and private sector for 1983 to 1984 are included, along with significant laws from the 95th through 97th Congresses. The appendix provides a compilation of information policy public laws, 1977 through 1984. Author

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N86-27131# Naval Postgraduate School, Monterey, Calif.
A SUMMARY OF THE NAVAL POSTGRADUATE SCHOOL RESEARCH PROGRAM Summary Report, 1 Oct. 1983 - 30 Sep. 1984
Gilbert T. Howard 30 Sep. 1985 404 p
(AD-A164845; NPS-012-85-001PR) Avail: NTIS HC A18/MF A01 CSCL 14/2

This report contains 232 summaries of research projects which were carried out under funding to the Naval Postgraduate School Research Program. This research was conducted under the areas of Computer Science, Mathematics, Administrative Sciences, Operations Research, National Security Affairs, Physics, Electrical and Computer Engineering, Meteorology, Aeronautics, Oceanography, and Mechanical Engineering. The table of contents identifies specific research topics. GRA

N86-27132# Naval Postgraduate School, Monterey, Calif.
EXPLOITING CAPABILITY CONSTRAINTS TO SOLVE GLOBAL, TWO DIMENSIONAL PATH PLANNING PROBLEMS
R. F. Richbourg, Neil C. Rowe, and Michael J. Zyda Jan. 1986 35 p refs
(AD-A164973; NPS52-86-006) Avail: NTIS HC A03/MF A01 CSCL 17/7

Mobile autonomous vehicles require the capability of planning routes over ranges that are too great to be characterized by local sensor systems. Completion of this task requires some form of map data. Much work has been done concerning planning paths through local areas, those which can be scanned by on-board sensor systems. However, planning paths based on long range map data is a very different problem. Extant solution techniques require the search of discrete, node and link representations which characterize continuous, two dimensional problem environments. The authors assume the availability of topographic data organized into regions of homogenous traversal cost. Given this, they present a solution technique for the long range planning problem which relies on a Snell's Law heuristic to limit a graph search for the optimal solution. GRA

N86-27133# Naval Postgraduate School, Monterey, Calif.
UNITED STATES TECHNOLOGY TRANSFER TO PERU AND VENEZUELA M.S. Thesis
Alfredo Arrisueno and Ramon Peraza Dec. 1985 134 p refs
(AD-A164995) Avail: NTIS HC A07/MF A01 CSCL 05/4

Technology has a decisive influence on the daily lives of most of the world population. Historically, technology has moved from one part of the world to another by a continuous process or transfer. However, the resultant transference has been quite uneven in its geographical impact, and there is a concern that the technology gap between the developed countries and the less developed countries is widening. Concern about the widening of the gap and the need to increase the technology transfer process, is the very essence of the economic growth and development needs of less developed countries. This Thesis will examine the gap, and an attempt will be made to determine guidelines, initiatives, and mechanisms to facilitate the transfer of U.S. technology to Latin America and specifically to Peru and Venezuela. GRA

N86-27134# Office of Naval Research, London (England).
EUROPEAN SCIENCE NOTES. VOLUME 40, NUMBER 4 Monthly Report
C. J. Fox Apr. 1986 37 p

(AD-A165292; AD-F630715; ESN-40-4) Avail: NTIS HC A03/MF A01 CSCL 05/2

ESN is a monthly publication with brief articles on recent developments in European scientific research. Partial contents: Center of Molecular Biology, Canto Blanco (Madrid), Spain; Life Science Research at Trent Polytechnic, Nottingham, UK; Artificial Intelligence at Milan; Ceramic Matrix Composites; Fluid Mechanics, Combustion, and Hydroacoustics at Bertin and Co. (France); Fluid Mechanics Research at Laboratoire National d'Hydraulique (France); Lasers and Electro-Optics at CISE in Milan. GRA

N86-27135# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Mathematical Statistics.
ON ROADS WITH NO OVERTAKING
A. J. Koning Sep. 1985 45 p
(CWI-MS-R8508; B8577114; ESA-86-96987) Avail: NTIS HC A03/MF A01

A road which narrows at bottleneck from an infinite-lane road to a one-lane road is studied with two independent stochastic processes. At the bottleneck an equilibrium headway can be viewed as the maximum of a shifted exponential random variable and a minimum headway. After the bottleneck the situation becomes far more complicated. However, at a sufficently large distance from the bottleneck an equilibrium headway may be approximated by the maximum of a shifted exponential random variable and a minimum headway, with the parameters of the shifted exponential random variable depending on the desired speed of the car. The distance from the bottleneck only affects the location, not the scale. Results are checked by Monte Carlo experiments. ESA

88 SPACE SCIENCES (GENERAL)

N86-27136*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SPACE STATION PLANETOLOGY EXPERIMENTS (SSPEX)
Ronald Greeley, ed. (Arizona State Univ., Tempe) and Richard J. Williams, ed. May 1986 97 p Workshop held in Flagstaff, Ariz., 20-22 Jun. 1985
(Contracts NCC9-14; NAS9-17023)
(NASA-CP-2424; S-554; NAS 1.55:2424) Avail: NTIS HC A05/MF A01 CSCL 03A

A meeting of 50 planetary scientists considered the uses of the Space Station to support experiments in their various disciplines. Abstracts (28) present concepts for impact and aeolian processes, particle formation and interaction, and other planetary science experiments. Summaries of the rationale, hardware concepts, accomodations, and recommendations are included. For individual titles, see N86-27137 through N86-27168.

N86-27137*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SPACE STATION IMPACT EXPERIMENTS **c90**
Peter Schultz (Brown Univ., Providence, R. I.), Thomas Ahrens (California Inst. of Tech., Pasadena), W. M. Alexander (Baylor Univ., Waco, Tex.), Mark Cintala, Donald Gault (Murphys Center of Planetology, Calif.), Ronald Greeley (Arizona State Univ., Tempe), B. Ray Hawke (Hawaii Univ., Honolulu), Kevin Housen (Boeing Aerospace Co., Seattle, Wash.), and Robert Schmidt *In its* Space Station Planetology Experiments (SSPEX) May 1986 5 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

Four processes serve to illustrate potential areas of study and their implications for general problems in planetary science. First, accretional processes reflect the success of collisional aggregation over collisional destruction during the early history of the solar system. Second, both catastrophic and less severe effects of impacts on planetary bodies survivng from the time of the early solar system may be expressed by asteroid/planetary spin rates, spin orientations, asteroid size distributions, and perhaps the origin of the Moon. Third, the surfaces of planetary bodies directly record the effects of impacts in the form of craters; these records have wide-ranging implications. Fourth, regoliths evolution of asteroidal surfaces is a consequence of cumulative impacts, but the absence of a significant gravity term may profoundly affect the retention of shocked fractions and agglutinate build-up, thereby biasing the correct interpretations of spectral reflectance data. An impact facility on the Space Station would provide the controlled conditions necessary to explore such processes either through direct simulation of conditions or indirect simulation of certain parameters. B.G.

N86-27138*# Iowa State Univ. of Science and Technology, Ames.
SEDIMENT-TRANSPORT (WIND) EXPERIMENTS IN ZERO-GRAVITY **c90**
James Iverson, Dale Gillette (National Oceanic and Atmospheric Administration, Boulder, Colo.), Ronald Greeley (Arizona State Univ., Tempe), Jeff Lee, Ian Mackinnon (New Mexico Univ., Albuquerque), John Marshall (New Mexico Univ.), William Nickling (Guelph Univ., Ontario) 08(California Inst. of Tech., Pasadena.), Brad Werner, Bruce White, and Steve Williams (Arizona State Univ., Tempe.) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 6 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

The carousel wind tunnel (CWT) can be a significant tool for the determination of the nature and magnitude of interparticlar forces at threshold of motion. By altering particle and drum surface electrical properties and/or by applying electric potential difference across the inner and outer drums, it should be possible to separate electrostatic effects from other forces of cohesion. Besides particle trajectory and bedform analyses, suggestions for research include particle aggregation in zero and subgravity environments, effect of suspension-saltation ratio on soil abrasion, and the effects of shear and shearfree turbulence on particle aggregation as applied to evolution of solar nebula. B.G.

N86-27139*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PARTICLE FORMATION AND INTERACTION **c92**
Steven Squyres, George J. Corso (Northwestern Univ., Evanston, Ill.), Lynn Griffiths (Management and Technical Services Co., Washington, D.C.), Ian Mackinnon (New Mexico Univ., Albuquerque), John Marshall, Joseph A. Nuth, III (National Aeronautics and Space Administration, Washington, D.C.), Brad Werner (California Inst. of Tech., Pasadena), and John Wolfe (San Jose State Univ., Calif.) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 4 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

A wide variety of experiments can be conducted on the Space Station that involve the physics of small particles of planetary significance. Processes of interest include nucleation and condensation of particles from a gas, aggregation of small particles into larger ones, and low velocity collisions of particles. All of these processes could be investigated with a general purpose facility on the Space Station. The microgravity environment would be necessary to perform many experiments, as they generally require that particles be suspended for periods substantially longer than are practical at 1 g. Only experiments relevant to planetary processes will be discussed in detail here, but it is important to stress that a particle facility will be useful to a wide variety of scientific disciplines, and can be used to address many scientific problems. Author

N86-27140*# National Aeronautics and Space Administration, Washington, D.C.
REPORT ON OPPORTUNITIES AND/OR TECHNIQUES FOR HIGH-CALIBER EXPERIMENTAL RESEARCH (OTHER) PROPOSALS FOR SSPEX **c90**
Joseph A. Nuth, III, George Corso (Northwestern Univ., Evanston, Ill.), Donald DeVincenzi, Al Duba (Lawrence Livermore National Lab., Calif.), John Freeman (Rice Univ., Houston, Tex.), Ramon

Lopez, James Stephens (Jet Propulsion Lab., California Inst. of Tech., Pasadena), Ian Strong (Los Alamos National Lab., N. Mex.), and John Wolfe (San Jose State Univ., Calif.) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 5 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

Brief discriptions of the following 13 experiments are included: ultrahigh vacuum petrology facility; artificial comet free flyer; artificial comet (tethered); cosmic dust detector; cosmic dust collector; dust collection using tethered satellites; artificial magnetosphere; microgravity petrological studies; slitless ultraviolet spectrometer; orbital determination and capture experiment (ODACE); high velocity sputtering of amorphous silicates; particle release experiments; and calibration of gamma and X-ray remote sensing-probes. B.G.

N86-27141*# California Inst. of Tech., Pasadena. Seismological Lab.
A PLANETARY ULTRA HYPERVELOCITY IMPACT MECHANICS AND SHOCK WAVE SCIENCE FACILITY c14
Thomas J. Ahrens *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 5 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

Using the concept of intercepting orbits from a pair of Space Station serviced free flyers, a class of impact and shock wave experiments pertinent to planetary science can be performed. One proposed free flying vehicle is an impactor dispensor, and the second is the impact laboratory. How collision is achieved by utilizing essentially twice orbital velocity is demonstrated. The impactor dispensor contains a series of small flyer plates or other projectiles which are launched into the trajectory of the impactor laboratory at appropriate positions. The impactor laboratory is a large impact tank similar to those in terrestrial gun laboratories, except that it contains a supply of targets and instrumentation such as high speed cameras, flash X-ray apparatus and digital recorders. Shock and isentropic pressures of up to 20 Mbar are achievable with such a system which provides 15 km/sec impact velocities for precisely oriented projectiles. B.G.

N86-27142*# California Inst. of Tech., Pasadena. Seismological Lab.
PROPOSED EARTH BASED CRATERING EXPERIMENTS AT LOW G IN HARD VACUUM c91
Thomas J. Ahrens *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

In order to address the question of whether the cratering scale which was developed can be extrapolated to low velocity (of planetesimals appropriate for conditions during accretion of the planets and the impact mechanics of encounters of both asteroids and the solid objects which comprise the rings of the outer major planets), a series of experiments at low gravity and at high vacuum are proposed. Specific issues which could be addressed include: the effect of very low gravity on cratering efficiency and final crater shape; and the dynamics of impact into a strengthless spherical and ellipsoidal liquid target. Author

N86-27143*# Baylor Univ., Waco, Tex. Dept. of Physics.
MASS LOADING OF THE EARTH'S MAGNETOSPHERE BY MICRON SIZE LUNAR EJECTA. 1: EJECTA PRODUCTION AND ORBITAL DYNAMICS IN CISLUNAR SPACE c90
W. M. Alexander, W. G. Tanner, P. D. Anz, and A.-L. Chen *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

Particulate matter possessing lunar escape velocity sufficient to enhance the cislunar meteroid flux was investigated. While the interplanetary flux was extensively studied, lunar ejecta created by the impact of this material on the lunar surface is only now being studied. Two recently reported flux models are employed to calculate the total mass impacting the lunar surface due to sporadic meteor flux. There is ample evidence to support the contention that the sporadic interplanetary meteoroid flux enhances the meteroid flux of cislunar space through the creation of micron and submicron lunar ejecta with lunar escape velocity. B.G.

N86-27144*# Baylor Univ., Waco, Tex. Dept. of Physics.
MASS LOADING OF THE EARTH'S MAGNETOSPHERE BY MICRON SIZE LUNAR EJECTA. 2: EJECTA DYNAMICS AND ENHANCED LIFETIMES IN THE EARTH'S MAGNETOSPHERE c90
W. M. Alexander, W. G. Tanner, P. D. Anz, and A.-L. Chen *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

Extensive studies were conducted concerning the indivdual mass, temporal and positional distribution of micron and submicron lunar ejecta existing in the Earth-Moon gravitational sphere of influence. Initial results show a direct correlation between the position of the Moon, relative to the Earth, and the percentage of lunar ejecta leaving the Moon and intercepting the magnetosphere of the Earth at the magnetopause surface. It is seen that the Lorentz Force dominates all other forces, thus suggesting that submicron dust particles might possibly be magnetically trapped in the well known radiation zones. B.G.

N86-27145*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
LOW-GRAVITY IMPACT EXPERIMENTS: PROGRESS TOWARD A FACILITY DEFINITION c91
Mark J. Cintala *In its* Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

Innumerable efforts were made to understand the cratering process and its ramifications in terms of planetary observations, during which the role of gravity has often come into question. Well known facilities and experiments both were devoted in many cases to unraveling the contribution of gravitational acceleration to cratering mechanisms. Included among these are the explosion experiments in low gravity aircraft, the drop platform experiments, and the high gravity centrifuge experiments. Considerable insight into the effects of gravity was gained. Most investigations were confined to terrestrial laboratories. It is in this light that the Space Station is being examined as a vehicle with the potential to support otherwise impractical impact experiments. The results of studies performed by members of the planetary cratering community are summarized. Author

N86-27146*# Indiana Univ. Northwest, Gary.
COSMIC DUST COLLECTION WITH A SUB-SATELLITE TETHERED TO A SPACE STATION c90
G. J. Corso *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p Prepared in cooperation with Northwestern Univ., Evanston, Ill. (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

The number concentration and density of 1 micron and submicron sized grains in interplanetary space, as well as their relation to the larger zodical dust particles, and the importance of the Beta meteoroid phenomenon are currently being questioned. The best approach to collecting large numbers of intact micron and submicron sized cosmic dust particles in real time while avoiding terrestrial and man made contamination would be to employ a tethered subsatellite from a space station down into the Earth's atmosphere. Such a subsatellite tied to the space shuttle by a 100 km long tether is being developed. It is also possible that a permanent space station would allow the use of a tether even longer that 100 km. It should be noted that the same tethered collectors could also be employed to study the composition and

flux of man made Earth orbiting debris in any direction within 100 km or so of the space station. B.G.

N86-27147*# National Aeronautics and Space Administration, Washington, D.C.
SPACE STATION SCIENCE LAB MODULE c18
D. L. DeVincenzi *In* NASA. Lyndon B. Johnson Space Center Space Statiaon Planetology Experiments (SSPEX) May 1986 5 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

The Science Lab Module (SLM), a key component of the proposed Space Station (SS) orbiting complex, is undergoing intensive study during the project design phase which is currently underway. The SLM is one of the two laboratory modules which, together with two habitation modules, comprise the core elements of the SS reference configurations. Current project emphasis is to configure the SLM as a national science laboratory module facility which would have four major functions: maximize life sciences research potential, support operations of attached payloads, provide shirtsleeve environment for other payload instrument servicing, and support other science requirements. The design studies are focusing on outfitting a common module basic design to accommodate the four specific functions. Although design work for outfitting the SLM for life sciences research is underway, science requirements for the other sciences and functions are not as well developed. Author

N86-27148*# Lawrence Livermore National Lab., Calif.
ELECTRICAL CONDUCTIVITY OF CARBONACEOUS CHONDRITES AND ELECTRIC HEATING OF METEORITE PARENT BODIES c91
Al Duba *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p refs (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

The electrical conductivity of samples of the Murchison and Allende carbonaceous chondrites is 4 to 6 magnitudes greater than rock forming minerals such as Olivine up to 700 C. The remarkably high electrical conductivity of these meteorites is attributed to carbon at grain boundaries. The environment in the wake of the space station can be exploited to produce conditions which will allow pyrolysis of carbonaceous chondrites. An experimental package consisting of a one square meter shield attached to a 15 cm diameter by 40 cm long furnace and tied to a conductance bridge, furnace controller, and digital voltmeter inside the space station via umbilical cable could make the required measurements. Since heating rates as low as 0.1 C/hour are required to study kinetics of the pyrolysis reations which are the cause of the high conductivity of the carbonaceous chondrites, experimental times up to 3 months will be needed. B.G.

N86-27149*# Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.
THE ORBIT PROPERTIES OF COLLIDING CO-ORBITING BODIES c90
John W. Freeman *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

It is generally assumed that an ensemble of small bodies located in similar Keplarian orbits will, because of collisions, tend to disperse into more and more dissimilar orbits. For example, it is thought that the asteroids may represent the remnants of a few larger bodies that broke up or failed to fully accrete. A proposed experiment using the space station consists of an ensemble of small bodies or particles released gently from a central location in a large chamber, much like the breaking of billiard balls. The particles would them co-orbit and occasionally collide. Their subsequent behavior could be monitored by several video recorders, their linear and angular velocities before and after collision calculated, and their general behavior studied. This experiment could yield results of fundamental importance for theories of the origin of the planets, asteroids, comets, and probably ring systems. B.G.

N86-27150*# National Oceanic and Atmospheric Administration, Boulder, Colo.
SMALL LINEAR WIND TUNNEL SALTATION EXPERIMENTS: SOME EXPERIENCES c09
D. A. Gillette and P. R. Owen *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p Prepared in cooperation with Imperial College of Science and Technology, London, England (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

Since the wind tunnels proposed to be used for the Space Station Planetology Experiments are of a rather limited size, some experience and techniques used for saltation experiments in a small linear wind tunnel may be of interest. Three experiments will be presented. The first concerns a length effect of saltation mass flux in which the size of the wind tunnel exaggerates the physical process taking place. The second experiment concerns a nonoptical technique that does not interfere with flow and by which momentum flux to the floor may be measured. The technique may also be used to calculate saltation flux (using appropriate assumptions). The third experiment concerns the use of the momentum equation to estimate momentum fluxes by difference. Author

N86-27151*# Department of Energy, Mines, and Resources, Ottawa (Ontario). Microgravity Cratering Working Group.
IMPACT EXPERIMENTATION AND THE MICROGRAVITY ENVIRONMENT: AN OVERVIEW c90
Richard A. F. Grieve *In* NASA. Lyndon B. Johnson Space Center Sapce Station Planetology Experiments (SSPEX) May 1986 2 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

Impact is an ubiquitous physical process in the solar system. It occurs on all solid bodies and operates over a spectrum of scales, influencing geologic processes ranging from accretion, the early evolution of planetary bodies, the petrogenetic and spatial relations of lunar samples, the surface characteristics and interpretation of spectral data of asteroidal bodies, to the nature of some meteorites. Understanding impact phenomena is therefore paramount in constraining and underpinning a large number of research efforts into fundamental planetary geology. Gravity is an important parameter in impact processes. The physical environment offered by the Space Station represents an unique opportunity to extend the experimental aspect of impact studies into the microgravity (less than 1 g) regime. Through the use of free floating targets, it may be possible to explore in detail phenomena associated with the collision of bodies. Such experiments can address questions regarding early and late accretional processes, catastrophic disruption and asteroidal evolution, as well as the effects of large impacts on the momentum and spin of the target bodies. The last question is of considerable topical interest with respect to the hypothesized origin of the moon by a Mars-sized impact on Earth. B.G.

N86-27152*# National Aeronautics and Space Administration, Washington, D.C.
EXOBIOLOGY EXPERIMENT CONCEPTS FOR SPACE STATION c55
L. D. Griffiths (Management and Technical Services Co., Washington, D.C.) and D. L. DeVincenzi *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 1 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

The exobiology discipline uses ground based and space flight resources to conduct a multidiscipline research effort dedicated to understanding fundamental questions about the origin, evolution, and distribution of life and life related molecules throughout the universe. Achievement of this understanding requires a methodical research strategy which traces the history of the biogenic elements from their origins in stellar formation processes through the

chemical evolution of molecules essential for life to the origin and evolution of primitive and, ultimately, complex living species. Implementation of this strategy requires the collection and integration of data from solar system exploration spacecraft and ground based and orbiting observatories and laboratories. The Science Lab Module (SLM) of the Space Station orbiting complex may provide an ideal setting in which to perform certain classes of experiments which form the cornerstone of exobiology research. These experiments could demonstrate the pathways and processes by which biomolecules are synthesized under conditions that simulate the primitive Earth, planetary atmospheres, cometary ices, and interstellar dust grains. Exobiology experiments proposed for the Space Station generally fall into four classes: interactions among gases and grains (nucleation, accretion, gas-grain reactions), high energy chemistry for the production of biomolecules, physical and chemical processes occurring on an artificial comet, and tests of the theory of panspermia. Author

N86-27153*# Iowa State Univ. of Science and Technology, Ames. Dept. of Aerospace Engineering.

SEDIMENT-TRANSPORT EXPERIMENTS IN ZERO-GRAVITY **c12**

James D. Iversen and Ronald Greeley (Arizona State Univ., Tempe) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)

Avail: NTIS HC A05/MF A01 CSCL 03A

One of the important parameters in the analysis of sediment entrainment and transport is gravitational attraction. The availability of a laboratory in Earth orbit would afford an opportunity to conduct experiments in zero and variable gravity environments. Elimination of gravitational attraction as a factor in such experiments would enable other critical parameters (such as particle cohesion and aerodynamic forces) to be evaluated much more accurately. A Carousel Wind Tunnel (CWT) is proposed for use in conducting experiments concerning sediment particle entrainment and transport in a space station. In order to test the concept of this wind tunnel design a one third scale model CWT was constructed and calibrated. Experiments were conducted in the prototype to determine the feasibility of studying various aeolian processes and the results were compared with various numerical analysis. Several types of experiments appear to be feasible utilizing the proposed apparatus. Author

N86-27154*# Arizona State Univ., Tempe.

DESIGN AND CALIBRATION OF THE CAROUSEL WIND TUNNEL **c09**

R. N. Leach, R. Greeley, J. Iversen (Iowa State Univ. of Science and Technology, Ames), B. White (California Univ., Davis.), and J. R. Marshall *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p (For primary document see N86-27136 17-88)

Avail: NTIS HC A05/MF A01 CSCL 03A

In the study of planetary aeolian processes the effect of gravity is not readily modeled. Gravity appears in the equations of particle motion along with interparticle forces but the two terms are not separable. A wind tunnel that would permit variable gravity would allow separation of the forces and aid greatly in understanding planetary aeolian processes. The design Carousel Wind Tunnel (CWT) allows for a long flow distance in a small sized tunnel since the test section is a continuous circuit and allows for a variable pseudo gravity. A prototype design was built and calibrated to gain some understanding of the characteristics of the design and the results presented. B.G.

N86-27155*# Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.

A MAGNETOSPHERIC SIMULATION AT THE SPACE STATION **c14**

R. E. Lopez, J. W. Freeman, and F. C. Michel *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 1 p (For primary document see N86-27136 17-88)

Avail: NTIS HC A05/MF A01 CSCL 03A

It is proposed that a strong magnet (terrella) be flown at or near the Space Station to create an artificial magnetosphere in a laboratory setting. The relative flow of the ionosphere past the terrella will constitute a plasma wind that will interact with the magnetic field of the terrella to produce a localized magnetosphere. This object could then be extensively studied using diagnostic probes attached to the Space Station, or with free flyers. The space and storage requirements would be minimal, since the experiment would be conducted outside the space station. The total equipment would consist of several terrella (with varying surface conductivities), approximately 3 small magnetometer/plasma diagnostic packages, and several gas canisters for upstream seeding. Power requirements would be approximately 60 watts. Several track mounted tethers, each approximately or $>$ 200 m long in length, with track parallel to the orbital motion and 100 m long, are also needed. Astronaut time needed would be minimal in the tethered configuration (approximately 4 man hours/week). A free flying configuration, while not needing the tether track, would require much more human interaction. Author

N86-27156*# Arizona State Univ., Tempe. Dept. of Geology.

ELECTROSTATIC AGGREGATION OF FINELY-COMMINUTED GEOLOGICAL MATERIALS **c12**

J. R. Marshall and R. Greeley *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p (For primary document see N86-27136 17-88)

Avail: NTIS HC A05/MF A01 CSCL 03A

Electrostatic forces are known to have a significant effect on the behavior of finely comminuted particulate material: perhaps the most prevalent expression of this being electrostatic aggregation of particles into relatively coherent clumps. However, the precise role of electrostatic attraction and repulsion in determining the behavior of geological materials (such as volcanic ash and aeolian dust) is poorly understood. Electrostatic aggregation of fine particles is difficult to study on Earth either in the geological or laboratory environment principally because the material in an aggregated state remains airborne for such a short period of time. Experiments conducted in the NASA/JCS - KC135 aircraft are discussed. The aircraft experiments are seen as precursors to more elaborate and scientifically more comprehensive Shuttle or Space Station activities. B.G.

N86-27157*# Guelph Univ. (Ontario).

THE INITIATION OF GRAIN MOVEMENT BY WIND **c46**

W. G. Nickling *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p (For primary document see N86-27136 17-88)

Avail: NTIS HC A05/MF A01 CSCL 03A

When air blows across the surface of dry, loose sand, a critical shear velocity must be achieved to inititate motion. Since most natural sediments consist of a range of grain sizes, fluid threshold for any sediment cannot really be defined by a finite value but should be viewed as a threshold range which is a function of the mean size, sorting, and packing of the sediment. In order to investigate the initiation of particle movement by wind, a series of wind tunnel tests were carried out on a range of screened sands and commercially available glass beads of differing sizes, sorting, and shape characteristics. In addition, individual samples of the glass beads were mixed to produce r ' ier poorly sorted bimodal distributions. Test results suggest th.t when velocity is slowly increased over the sediment surface the smaller or more exposed grains are first entrained by the fluid drag of the air either in surface creep or in saltation. As velocity continues to rise, the larger more protected grains may also be moved by fluid drag. The data also indicate that predicted values based on the modified Bagnold equation fall within the range of threshold values defined by the transition section of the grain movement/shear velocity plots. Moreover, the predicted values are very similar to the threshold values derived for the point maximum inflection on the curves. Author

N86-27158*# National Aeronautics and Space Administration, Washington, D.C.
NUCLEATION EXPERIMENTS IN A MICROGRAVITY ENVIRONMENT **c12**
J. A. Nuth, J. E. Allen, Jr. (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.), L. U. Lilleleht (Virginia Univ., Charlottesville), I. D. R. Mackinnon (Microbeam, Inc., Houston, Tex.), F. J. M. Rietmeijer (National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.), and J. R. J. M. Stephens (Los Alamos National Lab., N. Mex.) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

A simple experimental apparatus is described in which a wide variety of vapor phase nucleation studies of refractory materials could be performed aboard NASA's KC-135 Research Aircraft. The chief advantage of a microgravity environment for these studies is the expected absence of thermally driven convective motions in the gas. The absence of convection leads to much more accurate knowledge of both the temperature distribution in the system and the time evolution of the refractory vapor concentration as a function of distance from the crucible. The evolution of the apparatus will be described as more experience is gained with the microgravity environment. Such experiments will be used to prepare for similar ones carried out aboard either the shuttle or Space Station where considerably longer duration experiments are possible. Author

N86-27159*# National Aeronautics and Space Administration, Washington, D.C.
ULTRAVIOLET SPECTROSCOPY OF METEORIC DEBRIS: IN SITU CALIBRATION EXPERIMENTS FROM EARTH ORBIT **c90**
Joseph A. Nuth, III, Thomas J. Wdowiak (Alabama Univ., Birmingham), and William R. Kubinec (Charleston Coll., S.C.) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments May 1986 2 p Previously announced as N86-23523 (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

It is proposed to carry out slitless spectroscopy at ultraviolet wavelengths from orbit of meteoric debris associated with comets. The Eta Aquarid, Orionid/Halley, and the Persied/1962 862 Swift-Tuttle showers would be principal targets. Low light level, ultraviolet video technique will be used during night side of the orbit in a wide field, earthward viewing mode. Data will be stored in compact video cassette recorders. The experiment may be configured as a GAS package or in the HITCHHIKER mode. The latter would allow flexible pointing capability beyond that offered by shuttle orientation of the GAS package, and doubling of the data record. The 1100 to 3200 A spectral region should show emissions of atomic, ionic, and molecular species of interest on cometary and solar system studies. Author

N86-27160*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
LOW GRAVITY FACILITIES FOR SPACE STATION PLANETOLOGY EXPERIMENTS **c14**
Paul A. Penzo *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

For experimentation, space offers a unique environment which is unobtainable on Earth. One characteristic is a gravity force less than 1 g, where g is the mean Earth gravity acceleration of 9.8 m/sq s. The production of uniform gravity levels above zero g in space is discussed in relationship to experimental needs. For planetology experiments, providing gravity in space will make it possible to more nearly simulate conditions on natural bodies. The g-level is but one parameter involved in the design of a specific experiment. Other requirements may be: g-level range; g-level tolerance value; Coriolis tolerance value; volume requirement; g-level duration; power and materials for the experiment; and automated or man-tended operation. These requirements, and certainly others, will dictate the type of facility which should be considered. The use of the Space Station or the Tethered Satellite System configurations is discussed. B.G.

N86-27161*# Brown Univ., Providence, R. I. Dept. of Geological Sciences.
DEBRIS-CLOUD COLLISIONS: ACCRETION STUDIES IN THE SPACE STATION **c90**
P. H. Schultz and D. E. Gault (Murphys Center of Planetology, Calif.) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

The growth of planetesimals in the Solar system reflects the success of collisional aggregation over disruption. Recent experiments performed at the NASA-Ames Vertical Gun Range are discussed using the production of debris cloud impaction to model protoplanetary accretion. The impact experiment assessed the differences between clustered and single body impacts on particulate surfaces. The preliminary results would indicate that collisions between two debris clouds might produce aggregates, thereby increasing particle sizes, whereas a single particle impacting a particle results in disruption and comminution. Such an experiment could provide new insight for early planetary growth processes and for interpreting the record of this stage. The use of the microgravity environment of the Space Station to further the research is discussed. B.G.

N86-27162*# Brown Univ., Providence, R. I. Dept. of Geological Sciences.
IMPACTS OF FREE-FLOATING OBJECTS: UNIQUE SPACE STATION EXPERIMENTS **c12**
P. H. Schultz and D. E. Gault (Murphys Center of Planetology, Calif.) *In* NASA. Lyndon B. Johnson Space Center Space STation Planetology Experiments (SSPEX) May 1986 2 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

The transfer of momentum and kinetic energy between planetary bodies forms the basis for wide ranging problems in planetary science ranging from the collective long term effects of minor perturbations to the catastrophic singular effect of a major collision. Although the collisional transfer of momentum and energy was discussed over the last two decades, major issues remain that largely reflect current limitations in Earth based experimental conditions and 3-D numerical codes. Two examples with potential applications in a Space Station laboratory, are presented: asteroid spin rates and orientations, and planetary disruption/spin rates. Asteroid spin rate and orientation experiments are needed wherein free floating nonspining and spining objects of varying strength, porosity, and volatility are impacted at varying velocities and angles. A space station platform also could provide an opportunity to test important facets of planetary disruption/spin rate models by allowing freely suspended spherical targets of varying viscosities, internal density gradients, and spin rates. Author

N86-27163*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
HOW TO MAKE A COMET **c90**
James Stephens, R. Stephen Saunders, and Fraser Fanale (Hawaii Univ., Honolulu) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

The primary mandate of NASA is the study of the nature and origin of the solar system. The study of comets provides information about conditions and processes at the beginning of the solar system. Short period comets and their relatives, the near Earth asteroids may prove to be second only to the Sun in importance to the long term survival of civilization for two reasons: as a possible candidate for the cause of mass extinctions of life on Earth and as the material means for the expansion of civilization into the solar system and beyond. In the mean time comets are studied

by remote means. Laboratory investigations using synthetic cometary materials may add to the knowledge of these interesting objects. Dust and mantle formation are currently being studied by the use of comet sublimation experiments. Results of these experiments are discussed. B.G.

N86-27164*# California Inst. of Tech., Pasadena. Div. of Physics, Mathematics and Astronomy.
GRAIN DYNAMICS IN ZERO GRAVITY c12
B. T. Werner and P. K. Haff *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

The dynamics of granular materials has proved difficult to model, primarily because of the complications arising from inelastic losses, friction, packing, and the effect of many grains being in contact simultaneously. The kinetic model of granular systems is similar to the kinetic theory of gases, except that collisional energy losses are always present in the former and must be treated explicity. Few granular materials on Earth are describable by this limiting model, since gravity tends to collapse the grains into a high density state where Coulombic friction effects are dominant. The planned Space Station offers an unusual opportunity to test the kinetic grain model and to explore its predictions. Without gravity, the regime of low interparticle velocities (where an elastic description of the collision is still valid) can be investigated. This will allow for direct interpretation by dynamical computer simulations as well as by the kinetic theory. The dynamics of spherical grains inside a clear box would be examined. Results would be compared with the predictions of the kinetic theory and computer simulations. B.G.

N86-27165*# California Univ., Davis.
AEOLIAN PROCESSES ABOARD A SPACE STATION: SALTATION AND PARTICLE TRAJECTORY ANALYSIS c09
B. R. White, R. Greeley (Arizona State Univ., Tempe), J. D. Iversen (Iowa State Univ. of Science and Technology, Ames), and R. N. Leach (Santa Clara Univ., Calif.) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

The Carousel wind tunnel (CWT) proposed to study aeolian processes aboard a space station consists of two concentric rotating drums. The space between the two drums comprises the wind tunnel test section. Differential rates of rotation of the two drums would provide a wind velocity with respect to either drum surface. Preliminary results of measured velocity profiles made in a CWT prototype indicate that the wall bounded boundary layer profiles are suitable to simulate flat plate turbulent boundary layer flow. The two dimensional flat plate Cartesian coordinate equations of motion of a particle moving through the air are explained. In order to assess the suitability of CWT in the analysis of the trajectories of windblown particles, a series of calculations were conducted comparing cases for gravity with those of zero gravity. Results from the calculations demonstrate that a wind tunnel of the carousel design could be fabricted to operate in a space station environment and that experiments could be conducted which would yield significant results contributing to the understanding of the physics of particle dynamics. B.G.

N86-27166*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
A SYSTEM FOR CONDUCTING IGNEOUS PETROLOGY EXPERIMENTS UNDER CONTROLLED REDOX CONDITIONS IN REDUCED GRAVITY c12
R. J. Williams *In its* Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

The Space Shuttle and the planned Space Station will permit experimentation under conditions of reduced gravitational acceleration offering experimental petrologists the opportunity to study crystal growth, element distribution, and phase chemistry. In particular the confounding effects of macro and micro scale buoyancy-induced convection and crystal settling or floatation can be greatly reduced over those observed in experiments in the terrestrial laboratory. Also, for experiments in which detailed replication of the environment is important, the access to reduced gravity will permit a more complete simulation of processes that may have occurred on asteroids or in free space. A technique that was developed to control, measure, and manipulate oxygen fugacites with small quantities of gas which are recirculated over the sample is described. This system should be adaptable to reduced gravity space experiments requiring redox control. Experiments done conventionally and those done using this technique yield identical results done in a 1-g field. B.G.

N86-27167*# San Jose State Univ., Calif.
NEW TECHNIQUES FOR THE DETECTION AND CAPTURE OF MICROMETEOROIDS c90
J. H. Wolfe *In* NASA. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 1 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

In order to understand the origin and distribution of the biogenic elements and their compounds in the solar system, it will be necessary to study material from many classes of objects. Chemical, elemental, and isotopic measurements of returned samples of comets, asteroids, and possibly extrasolar system dust clouds would provide information on a particularly important class: the primitive objects. Extraterrestrial micron-sized particles in the vicinity of Earth are one source of such materials that might otherwise be inaccessible. The Space Station appears to be an eminently suitable platform from which to collect and detect these various particles. The primary challenge, however, is to collect intact, uncontaminated particles which will be encountered at tens of kilometers per seconds. A concept for a micrometeoroid detector that could be deployed from the Space Station was developed which uses a large area detector plate implanted with acoustic transducers. A concept of a nondestructive micrometeoroid collector for the Space Station was also developed. Particles collected would then be returned to Earth for subsequent analysis. Author

N86-27168*# Geological Survey, Flagstaff, Ariz.
MAPPING EXPERIMENT WITH SPACE STATION c43
Sherman S. C. Wu *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

Mapping of the Earth from space stations can be approached in two areas. One is to collect gravity data for defining topographic datum using Earth's gravity field in terms of spherical harmonics. The other is to search and explore techniques of mapping topography using either optical or radar images with or without reference to ground central points. Without ground control points, an integrated camera system can be designed. With ground control points, the position of the space station (camera station) can be precisely determined at any instant. Therefore, terrestrial topography can be precisely mapped either by conventional photogrammetric methods or by current digital technology of image correlation. For the mapping experiment, it is proposed to establish four ground points either in North America or Africa (including the Sahara desert). If this experiment should be successfully accomplished, it may also be applied to the defense charting systems. B.G.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N86-27169*# Wisconsin Univ., Madison. Dept. of Physics.
SMALL SCALE H I STRUCTURE AND THE SOFT X-RAY BACKGROUND

Keith Jahoda, Dan McCammon, and Felix J. Lockman (National Radio Astronomy Observatory, Charlottesville, Va.) 22 May 1986 15 p refs Submitted for publication
(Grant NAG5-629)
(NASA-CR-176674; NAS 1.26:176674) Avail: NTIS HC A02/MF A01 CSCL 03A

The observed anticorrelation between diffuse soft X-ray flux and H I column density has been explained as absorption of soft X-rays produced in a hot galactic halo, assuming that the neutral interstellar material is sufficiently clumped to reduce the soft X-ray absorption cross section by a factor of two to three. A 21 cm emission line study of H I column density variations at intermediate and high galactic latitudes to 10' spatial resolution has been done. The results confirm conclusions from preliminary work at coarser resolution, and in combination with other data appear to rule out the hypothesis that clumping of neutral interstellar matter on any angular scale significantly reduces X-ray absorption cross sections in the 0.13 - 0.28 keV energy range. It is concluded therefore that the observed anticorrelation is not primarily a consequence of absorption of soft X-rays produced in a hot galactic halo.
Author

N86-27170# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Inst. of Sound and Vibration Research.
THE IRAS REVISITED (LESSONS LEARNED FROM IRAS OPERATIONS) Final Report
L. Karsten, comp., W. vanLeeuwen, comp., F. Teule, G. Hameetman (National Aerospace Lab., Amsterdam, Netherlands), C. Slippens, R. Ely (Science Research Council, Chilton, England), and J. Gourlay ESA ESA Jul. 1985 131 p
(Contract ESA-6018/84-NL-PP(SC))
(FOK-TR-85-63; ESA-CR(P)-2167; ESA-86-96866) Avail: NTIS HC A07/MF A01

After the nominal end of the IRAS mission, in-orbit experiments to demonstrate IRAS reconfigurability aspects and to assess long term performance were initiated. In a computer memory reconfiguration, 3 blocks of 16k 16-bits RAM memory became available for data storage. In the original configuration, 2 blocks of these belonged to the redundant 32k computer system. Since during the operational mission no back-up mode was needed, a ROM implemented back-up mode for the normal safe mode was operated. The back-up mode software in ROM was called by RAM software to provide experiment specific data storage in the extended memories. This approach was also followed for the last experiment in which the satellite recovered from a deliberately saturated reaction wheel (23 Nms). All systems (not including the telescope) operated without substantial degradation. ESA

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

N86-27171*# San Diego State Univ., Calif. Dept. of Electrical and Computer Engineering.
PHOTOABSORPTION AND PHOTODISSOCIATION OF MOLECULES IMPORTANT IN THE INTERSTELLAR MEDIUM Annual Report, 15 May 1985 - 14 May 1986
Long C. Lee 2 Jun. 1986 34 p refs
(Grant NAGw-319)
(NASA-CR-176828; NAS 1.26:176828) Avail: NTIS HC A03/MF A01 CSCL 03B

In the period from May 15, 1985 to May 14, 1986, the photoabsorption and photodissociation cross sections of the interstellar radical of SO and the interstellar molecules of HCl, H2CO, and CH3CN were measured and the results were reported in scientific papers. In the meantime, a windowless apparatus is used to measure the photoabsorption and photodissociation cross sections of CO in the 90-105 nm region. The optical data obtained in this research program are needed for the determination of the formation and destruction rates of molecules and radicals in the interstellar medium. Accomplishments in this research period are summarized below.
Author

N86-26845*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ORGANIC CHEMISTRY OF MURCHISON METEORITE: CARBON ISOTOPIC FRACTIONATION
George U. Yuen (Arizona State Univ., Tempe), Neal E. Blair (North Carolina State Univ., Raleigh), David J. DesMarais, John R. Cronin (Arizona State Univ., Tempe), and Sherwood Chang *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 40 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

N86-27137*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SPACE STATION IMPACT EXPERIMENTS
Peter Schultz (Brown Univ., Providence, R. I.), Thomas Ahrens (California Inst. of Tech., Pasadena), W. M. Alexander (Baylor Univ., Waco, Tex.), Mark Cintala, Donald Gault (Murphys Center of Planetology, Calif.), Ronald Greeley (Arizona State Univ., Tempe), B. Ray Hawke (Hawaii Univ., Honolulu), Kevin Housen (Boeing Aerospace Co., Seattle, Wash.), and Robert Schmidt *In its* Space Station Planetology Experiments (SSPEX) May 1986 5 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27138*# Iowa State Univ. of Science and Technology, Ames.
SEDIMENT-TRANSPORT (WIND) EXPERIMENTS IN ZERO-GRAVITY
James Iverson, Dale Gillette (National Oceanic and Atmospheric Administration, Boulder, Colo.), Ronald Greeley (Arizona State Univ., Tempe), Jeff Lee, Ian Mackinnon (New Mexico Univ., Albuquerque), John Marshall (New Mexico Univ.), William Nickling (Guelph Univ., Ontario) 08(California Inst. of Tech., Pasadena.), Brad Werner, Bruce White, and Steve Williams (Arizona State Univ., Tempe.) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 6 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27140*# National Aeronautics and Space Administration, Washington, D.C.
REPORT ON OPPORTUNITIES AND/OR TECHNIQUES FOR HIGH-CALIBER EXPERIMENTAL RESEARCH (OTHER) PROPOSALS FOR SSPEX
Joseph A. Nuth, III, George Corso (Northwestern Univ., Evanston, Ill.), Donald DeVincenzi, Al Duba (Lawrence Livermore National Lab., Calif.), John Freeman (Rice Univ., Houston, Tex.), Ramon Lopez, James Stephens (Jet Propulsion Lab., California Inst. of Tech., Pasadena), Ian Strong (Los Alamos National Lab., N. Mex.), and John Wolfe (San Jose State Univ., Calif.) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 5 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27143*# Baylor Univ., Waco, Tex. Dept. of Physics.
MASS LOADING OF THE EARTH'S MAGNETOSPHERE BY MICRON SIZE LUNAR EJECTA. 1: EJECTA PRODUCTION AND ORBITAL DYNAMICS IN CISLUNAR SPACE
W. M. Alexander, W. G. Tanner, P. D. Anz, and A.-L. Chen *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27144*# Baylor Univ., Waco, Tex. Dept. of Physics.
MASS LOADING OF THE EARTH'S MAGNETOSPHERE BY MICRON SIZE LUNAR EJECTA. 2: EJECTA DYNAMICS AND ENHANCED LIFETIMES IN THE EARTH'S MAGNETOSPHERE
W. M. Alexander, W. G. Tanner, P. D. Anz, and A.-L. Chen *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology

Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27146*# Indiana Univ. Northwest, Gary.
COSMIC DUST COLLECTION WITH A SUB-SATELLITE TETHERED TO A SPACE STATION
G. J. Corso *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p Prepared in cooperation with Northwestern Univ., Evanston, Ill. (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27149*# Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.
THE ORBIT PROPERTIES OF COLLIDING CO-ORBITING BODIES
John W. Freeman *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27151*# Department of Energy, Mines, and Resources, Ottawa (Ontario). Microgravity Cratering Working Group.
IMPACT EXPERIMENTATION AND THE MICROGRAVITY ENVIRONMENT: AN OVERVIEW
Richard A. F. Grieve *In* NASA. Lyndon B. Johnson Space Center Sapce Station Planetology Experiments (SSPEX) May 1986 2 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27159*# National Aeronautics and Space Administration, Washington, D.C.
ULTRAVIOLET SPECTROSCOPY OF METEORIC DEBRIS: IN SITU CALIBRATION EXPERIMENTS FROM EARTH ORBIT
Joseph A. Nuth, III, Thomas J. Wdowiak (Alabama Univ., Birmingham), and William R. Kubinec (Charleston Coll., S.C.) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments May 1986 2 p Previously announced as N86-23523 (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27161*# Brown Univ., Providence, R. I. Dept. of Geological Sciences.
DEBRIS-CLOUD COLLISIONS: ACCRETION STUDIES IN THE SPACE STATION
P. H. Schultz and D. E. Gault (Murphys Center of Planetology, Calif.) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27163*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
HOW TO MAKE A COMET
James Stephens, R. Stephen Saunders, and Fraser Fanale (Hawaii Univ., Honolulu) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27167*# San Jose State Univ., Calif.
NEW TECHNIQUES FOR THE DETECTION AND CAPTURE OF MICROMETEOROIDS
J. H. Wolfe *In* NASA. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 1 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design see *18 Spacecraft Design Testing, and Performance.* For space stations see *15 Launch Vehicles and Space Vehicles.*

N86-27172*# Yale Univ., New Haven, Conn. Dept. of Geology and Geophysics.
EARLY DIFFERENTIATION OF THE MOON: EXPERIMENTAL AND MODELING STUDIES Final Report, 1 Feb. 1981 - 31 Jan. 1986
John Longhi 18 Jun. 1986 8 p
(Grant NAGw-175)
(NASA-CR-176817; NAS 1.26:176817) Avail: NTIS HC A02/MF A01 CSCL 03B

Major accomplishments include the mapping out of liquidus boundaries of lunar and meteoritic basalts at low pressure; the refinement of computer models that simulate low pressure fractional crystallization; the development of a computer model to calculate high pressure partial melting of the lunar and Martian interiors; and the proposal of a hypothesis of early lunar differentiation based upon terrestrial analogs. B.G.

N86-26854*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MEASUREMENTS OF PHYSICAL PROPERTIES OF MODEL TITAN ATMOSPHERES
Thomas W. Scattergood (State Univ. of New York, Stony Brook.), Sherwood Chang, Chris McKay, Bonnie OHara, and Glenn Carle *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 50 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

N86-26855*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPERIMENTAL BASIS FOR A TITAN PROBE ORGANIC ANALYSIS
C. P. McKay, T. W. Scattergood (State Univ. of New York Stony Brook.), W. J. Borucki, J. F. Kasting, and S. L. Miller (California Univ., San Diego, La Jolla) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 52 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

N86-26862*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NEW TECHNIQUES FOR THE DETECTION AND CAPTURE OF MICROMETEOROIDS
John H. Wolfe (San Jose State Univ., Calif.), Theodore E. Bunch, and Glenn C. Carle *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life May 1986 p 59 (For primary document see N86-26844 17-55)
Avail: NTIS HC A07/MF A01 CSCL 06C

N86-27142*# California Inst. of Tech., Pasadena. Seismological Lab.
PROPOSED EARTH BASED CRATERING EXPERIMENTS AT LOW G IN HARD VACUUM
Thomas J. Ahrens *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27145*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
LOW-GRAVITY IMPACT EXPERIMENTS: PROGRESS TOWARD A FACILITY DEFINITION
Mark J. Cintala *In its* Space Station Planetology Experiments

(SSPEX) May 1986 3 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

N86-27148*# Lawrence Livermore National Lab., Calif.
ELECTRICAL CONDUCTIVITY OF CARBONACEOUS CHONDRITES AND ELECTRIC HEATING OF METEORITE PARENT BODIES
Al Duba *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 2 p refs (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N86-27173*# American Science and Engineering, Inc., Cambridge, Mass.
SAROS: SOLAR ACTIVE REGION OBSERVATIONS FROM SPACELAB Final Report, 11 Feb. 1980 - 11 Nov. 1985
Allen S. Krieger 30 Dec. 1985 27 p refs
(Contract NAS5-26048)
(NASA-CR-177878; NAS 1.26:177878; ASE-5066) Avail: NTIS HC A03/MF A01 CSCL 03B

A definition study of the SAROS investigation was conducted. An instrument design and mode of operation was established which was consistent with the capabilities of the Space Transportation System. Upon completion of the definition phase study the program was placed on hold for approximately five years before being terminated. Consequently, the promise which this investigation held for understanding the heating processes in coronal loops remains unfulfilled. E.R.

N86-27174# Stanford Univ., Calif. Center for Space Science and Astrophysics.
OBSERVATIONS OF LOW-DEGREE P-MODE OSCILLATIONS IN 1984. COMMENTS ON TECHNIQUES FOR SPECTRAL DECONVOLUTION
Harald M. Henning and Philip H. Scherrer Sep. 1985 26 p
(Contract N00014-76-C-0207; Grant NSF ATM-77)
(AD-A164780; CSSA-ASTRO-85-23) Avail: NTIS HC A03/MF A01 CSCL 03/2

Global convective flows in the solar convection zone have been predicted by theoretical interpretations of the global-scale ordering of magnetic fields and activity centers and by theoretical analyses of rotating convection zones. Direct evidence of these flows in the photosphere has not previously been found despite several long-term efforts. The signatures of such flows have now been detected by analyzing the daily series of low-resolution Dopplergrams obtained at the Wilcox Solar Observatory at Stanford Univ. The signatures are patterns of alternating east and west flows with amplitudes on the order of 25 m/s and longitudinal extent of about 30 degrees. The patterns move across the solar disc at approximately the solar rotation rate and have lifetimes of at least several rotations. Boundaries of the fast and slow flows are often associated with large magnetic active regions. GRA

N86-27175# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
DIRECTORY OF MESOSCALE SOLAR RADIATION INFORMATION SOURCES
Nov. 1985 44 p
(Contract DE-AC02-83CH-10093)
(DE85-016868; SERI/SP-271-2715) Avail: NTIS HC A03/MF A01

This directory contains thirty-nine US networks. A network comprises three or more mesoscale sites that concurrently measured solar radiation for at least one year. Mesoscale solar radiation information consists of solar radiation data from sites 20 to 200 km apart. Actual data from the networks are not included but information is provided on their characteristics and on how to obtain the data. The directory also identifies readily available, valuable literature on mesoscale research results. DOE

N86-27139*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PARTICLE FORMATION AND INTERACTION
Steven Squyres, George J. Corso (Northwestern Univ., Evanston, Ill.), Lynn Griffiths (Management and Technical Services Co., Washington, D.C.), Ian Mackinnon (New Mexico Univ., Albuquerque), John Marshall, Joseph A. Nuth, III (National Aeronautics and Space Administration, Washington, D.C.), Brad Werner (California Inst. of Tech., Pasadena), and John Wolfe (San Jose State Univ., Calif.) *In* NASA. Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) May 1986 4 p (For primary document see N86-27136 17-88)
Avail: NTIS HC A05/MF A01 CSCL 03A

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer Earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N86-27176*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
THEORETICAL STUDY OF THE X-RAY EMISSION FROM ASTROPHYSICAL SHOCK WAVES Semiannual Report, 1 Jun. 1985 - 31 May 1986
John Raymond Jun. 1986 9 p refs
(Grant NAGw-528)
(NASA-CR-177318; NAS 1.26:177318; SAPR-4; SAPR-5) Avail: NTIS HC A02/MF A01 CSCL 03B

Theoretical X-ray emission spectra are needed to interpret the X-ray emission observed by many low and moderate resolution X-ray instruments, and to provide diagnosis of physical conditions for high resolution spectra. Over the past decade, a set of model codes which compute the X-ray and XUV emission for a wide set of physical conditions, including high or low densities, photoionized gas, and time-dependent ionization balance was developed. In the past year, the atomic rate coefficients in the code was improved. Further capabilities were added, and applied to several astrophysical problems. Author

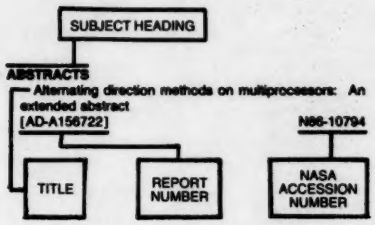
N86-27177# Severn Communications Corp., Severna Park, Md.
SURVEY OF ATMOSPHERIC RADIATION COMPONENTS FOR THE GAMMA AND COSMIC RAY ASTROPHYSICS BRANCH OF THE SPACE SCIENCE DIVISION OF THE NAVAL RESEARCH LABORATORY Final Report
31 May 1985 111 p
(Contract N00014-84-C-2089)
(AD-A165538) Avail: NTIS HC A06/MF A01 CSCL 03/1

A survey of atmospheric radiation components for the gamma and cosmic ray astrophysics branch of the Naval Research Laboratory has the following contents: Electron Capture Decay of Cosmic Rays; Cosmic Ray Heavy Ions at and Above 40,000 Feet; Neutron Generated Single Event Upsets in the Atmosphere; Nuclear Cross Sections, Cosmic Ray Propagation and Source Composition; Radiation Transport of Cosmic Ray Nuclei in Lunar Material and Radiation Doses; Non-Geometric Behavior of Nucleus Nucleus Total Inelastic Cross Sections; Environmental Models for Single Event Upset Estimation; Uncertainties in Cosmic Ray Source Composition; Late Stage in Acceleration of Cosmic Rays; Ultraheavy Cosmic Rays and Electron Capture; Propagation of Heavy Cosmic Ray Nuclei; On the Abundances of Ultraheavy Cosmic Rays; LET-Distributions and Doses of HZE Radiation Components at Near Earth Orbits; and Radiation Doses and LET (Linear Energy Transfer) Distributions of Cosmic Rays. GRA

99 GENERAL

No abstracts in this category.

Typical Subject Index Listing



The subject heading is the key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The NASA accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus* (NASA SP-7053).

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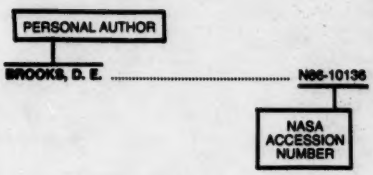

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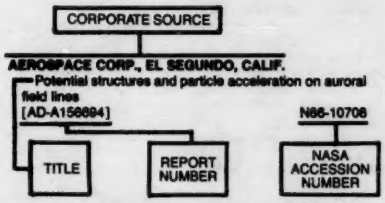

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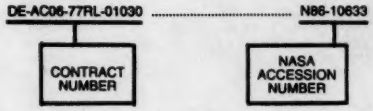

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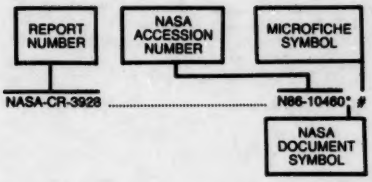

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INDIANA STATE LIBRARY
Serials Documents Section
140 North Senate Avenue
Indianapolis, IN 46204
(317) 232-3686

IOWA

UNIV. OF IOWA LIBRARIES
Govt. Documents Department
Iowa City, IA 52242
(319) 353-3318

KANSAS

UNIVERSITY OF KANSAS
Doc. Collect—Spencer Lib.
Lawrence, KS 66045
(913) 864-4662

KENTUCKY

UNIV. OF KENTUCKY LIBRARIES
Govt. Pub. Department
Lexington, KY 40506
(606) 257-3139

LOUISIANA

LOUISIANA STATE UNIVERSITY
Middleton Library
Govt. Docs. Dept.
Baton Rouge, LA 70803
(504) 388-2570

LOUISIANA TECHNICAL UNIV. LIBRARY
Documents Department
Ruston, LA 71272
(318) 257-4962

MAINE

UNIVERSITY OF MAINE
Raymond H. Fogler Library
Tri-State Regional Documents Depository
Orono, ME 04469
(207) 581-1680

MARYLAND

UNIVERSITY OF MARYLAND
McKeldin Lib.—Doc. Div.
College Park, MD 20742
(301) 454-3034

MASSACHUSETTS

BOSTON PUBLIC LIBRARY
Government Docs. Dept.
Boston, MA 02117
(617) 536-5400 ext. 226

MICHIGAN

DETROIT PUBLIC LIBRARY
Sociology Department
5201 Woodward Avenue
Detroit, MI 48202
(313) 833-1409

MICHIGAN STATE LIBRARY
P.O. Box 30007
Lansing, MI 48909
(517) 373-0640

MINNESOTA

UNIVERSITY OF MINNESOTA
Government Pubs. Division
409 Wilson Library
309 19th Avenue South
Minneapolis, MN 55455
(612) 373-7813

MISSISSIPPI

UNIV. OF MISSISSIPPI LIB.
Documents Department
University, MS 38677
(601) 232-5857

MONTANA

UNIV. OF MONTANA
Mansfield Library
Documents Division
Missoula, MT 59812
(406) 243-6700

NEBRASKA

NEBRASKA LIBRARY COMM.
Federal Documents
1420 P Street
Lincoln, NE 68508
(402) 471-2045
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NEVADA

UNIVERSITY OF NEVADA LIB.
Govt. Pub. Department
Reno, NV 89557
(702) 784-6579

NEW JERSEY

NEWARK PUBLIC LIBRARY
5 Washington Street
Newark, NJ 07101
(201) 733-7812

NEW MEXICO

UNIVERSITY OF NEW MEXICO
Zimmerman Library
Government Pub. Dept.
Albuquerque, NM 87131
(505) 277-5441

NEW MEXICO STATE LIBRARY
Reference Department
325 Don Gaspar Avenue
Santa Fe, NM 87501
(505) 827-2033, ext. 22

NEW YORK

NEW YORK STATE LIBRARY
Empire State Plaza
Albany, NY 12230
(518) 474-5563

NORTH CAROLINA

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Wilson Library
BA/SS Documents Division
Chapel Hill, NC 27515
(919) 962-1321

NORTH DAKOTA

UNIVERSITY OF NORTH DAKOTA
Chester Fritz Library
Documents Department
Grand Forks, ND 58202
(701) 777-2617, ext. 27
(In cooperation with North Dakota State Univ. Library)

OHIO

STATE LIBRARY OF OHIO
Documents Department
65 South Front Street
Columbus, OH 43215
(614) 462-7051

OKLAHOMA

OKLAHOMA DEPT. OF LIB.
Government Documents
200 NE 18th Street
Oklahoma City, OK 73105
(405) 521-2502

OKLAHOMA STATE UNIV. LIB.
Documents Department
Stillwater, OK 74078
(405) 624-6546

OREGON

PORTLAND STATE UNIV. LIB.
Documents Department
P.O. Box 1151
Portland, OR 97207
(503) 229-3673

PENNSYLVANIA

STATE LIBRARY OF PENN.
Government Pub. Section
P.O. Box 1601
Harrisburg, PA 17105
(717) 787-3752

TEXAS

TEXAS STATE LIBRARY
Public Services Department
P.O. Box 12927—Cap. Sta.
Austin, TX 78753
(512) 471-2996

TEXAS TECH UNIV. LIBRARY
Govt. Documents Department
Lubbock, TX 79409
(806) 742-2268

UTAH

UTAH STATE UNIVERSITY
Merrill Library, U.M.C. 30
Logan, UT 84322
(801) 750-2682

VIRGINIA

UNIVERSITY OF VIRGINIA
Alderman Lib.—Public Doc.
Charlottesville, VA 22901
(804) 924-3133

WASHINGTON

WASHINGTON STATE LIBRARY
Documents Section
Olympia, WA 98504
(206) 753-4027

WEST VIRGINIA

WEST VIRGINIA UNIV. LIB.
Documents Department
Morgantown, WV 26506
(304) 293-3640

WISCONSIN

MILWAUKEE PUBLIC LIBRARY
814 West Wisconsin Avenue
Milwaukee, WI 53233
(414) 278-3000

ST. HIST LIB. OF WISCONSIN
Government Pub. Section
816 State Street
Madison, WI 53706
(608) 262-4347

WYOMING

WYOMING STATE LIBRARY
Supreme Ct. & Library Bld.
Cheyenne, WY 82002
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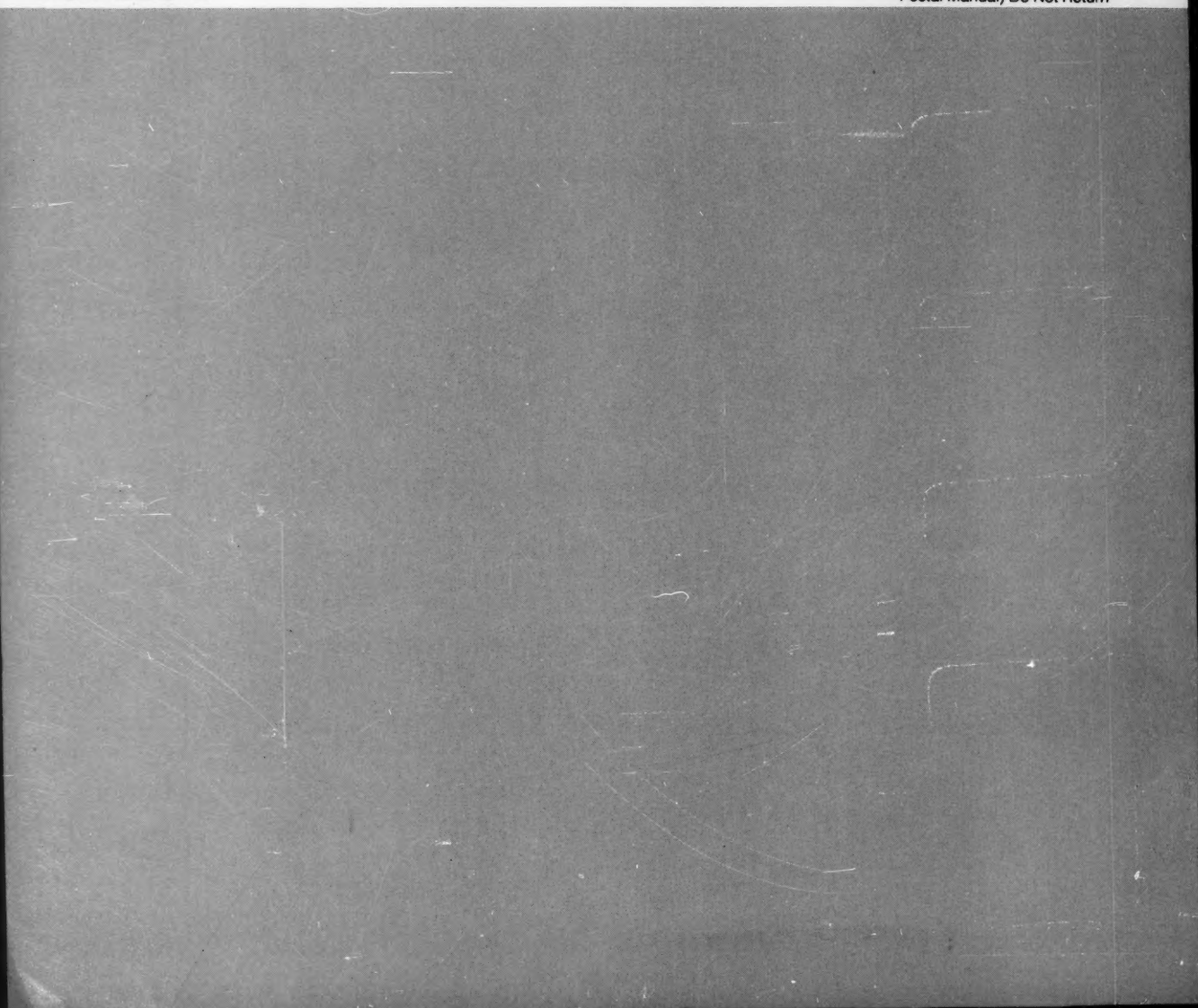
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